SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 1
JANUARY 1, 1970

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD_____iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

THE STRUCTURE AND PROPERTIES OF WATER,
D. Eisenberg, and W. Kauzmann.
New York, Oxford Univ Press, 1969. 296 p, 70 fig, 44 tab, 403 ref.

Descriptors: *Water structure, *Water properties, *Thermodynamics, Physical properties, Water vapor, Hydrogen bonding, Molecular structure, Electrical properties, Electrical studies, Spectroscopy, Optical properties, Nuclear magnetic resonance, X-ray diffraction, Infrared radiation, Analytical techniques, Reviews, Bibliographies.
Identifiers: *Water physical properties.

Some of the most important data on the nature and properties of water are summarized and the theories that are most effective in correlating these data are presented in a textbook intended for the scientist familiar with basic physical chemistry. The relationship of water structure to water properties is explained. Infrared and Raman spectra are covered in detail because they reveal so much about ice and liquid water structures. Other techniques of study including thermodynamics, spectroscopy, electrical studies, NMR, optics, X-ray diffraction, and vibrational spectroscopy are discussed and their findings are related to structural properties. Liquid water and water vapor models are presented. An extensive bibliography consists largely of recent works but also includes many older papers. (Knapp-USGS)
W70-00242

1B. Aqueous Solutions and Suspensions

THE STRUCTURE AND PROPERTIES OF WATER,
For primary bibliographic entry see Field 01A.
W70-00242

THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Baas-Becking Geobiological Lab.
William M. B. Roberts.
Mineral Deposita (Berlin), Vol 3, No 4, p 364-367, Dec 1968. 4 p, 1 tab, 8 ref.

Descriptors: *Pyrite, *Hydrates, *Suspension, *Iron oxides, *Aqueous solutions, Temperature, Atmospheric pressure, Hydrogen sulfide, Oxygen, Anaerobic conditions, Sediments, X-ray diffraction, Mineralogy.
Identifiers: Pyrite formation in aqueous solution.

Experiments conducted by the Baas-Becking Geobiological Research Laboratory of Australia on the formation of pyrite from hydrated iron oxides and sulfides in aqueous solutions are described. In carrying out the experiments, oxygen was rigorously excluded from the system and the pH was 5.6. During a later aging period a reaction takes place in which iron monosulfide is converted to pyrite at pH 5.85. The results confirm Berner's conclusions that pyrite will form during the sedimentary cycle in an anaerobic environment such as studies made on sediments from the Black Sea, and tidal flats of the Netherlands and off Massachusetts had indicated. (Gabriel-USGS)
W70-00244

02. WATER CYCLE

2A. General

ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
H. B. Osborn, and K. G. Renard.
J Hydrol, Vol 8, No 3, p 282-302, Jul 1969. 21 p, 20 fig, 1 tab, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Thunderstorms, *Storm structure, Arizona, Isohyets, Hyetographs, Hydrographs, Storm runoff, Runoff forecasting, Meteorlogy, Demonstration watersheds, Small watersheds.
Identifiers: Walnut Gulch Experimental Watershed.

The two largest runoff-producing storms for 10 yr of records, the first in 1964 and the second in 1967, recorded on the Walnut Gulch Experimental Watershed in southeastern Arizona are analyzed and compared. Both storms were non-frontal thunderstorms which produced peak discharges on the order of 1500 cfs per sq mi; in 1964 from a 2000-acre subwatershed, and in 1967 from an 84-acre subwatershed. During the 1967 storm rainfall of 3.35 inches in 45 min was recorded at one point on the watershed. Approximately 18 acre-ft of runoff was produced on the 84-acre subwatershed in the 1967 storm. Runoff-producing rainfall lasted for less than 60 min for both storms. For both storms, runoff per unit area decreased with increasing subwatershed size because of the large transmission losses in the ephemeral channels and because of the limited areal extent of the runoff-producing rainfall. (Knapp-USGS)
W70-00037

A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Harsha Desai, and David L. Raphael.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, p 59-73, 1967. 15 p, 5 fig, 4 tab, 5 ref.

Descriptors: *Streamflow forecasting, *Routing, *Statistical models, *Hydrographs, *Synthetic hydrology, *Markov processes, Stochastic processes, Rainfall-runoff relationships, Computer models.
Identifiers: Watershed models.

A model was developed to predict the surface flow resulting from precipitation during a given time period, using simpler computations than was possible with conventional methods. It was assumed that surface flow due to rainfall would approach that of an absorbing Markov chain process. The various transfer coefficients or probabilities can be estimated and a starting state can be specified. These transfer coefficients may not remain constant for the entire time interval in a hydrologic cycle under study, due to the varying soil moisture conditions, varying precipitations, and varying climate. To make some provision for this, the transfer coefficients were estimated as an average for the total time period. Except for the initial time period of 2 days, the estimated flows were very close to the actual flows. In its application to the Susquehanna River Basin, the model used only 1 absorbing state due to the lack of sufficient data. The model was also able to give the total response behavior of the system as a whole. It was possible to estimate the amounts lost to the 3 absorbing states from the system during the total time period. (Knapp-USGS)
W70-00053

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
Colorado State Univ., Fort Collins.
Robert A. Longenbaugh.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 74-83, 1967. 10 p, 7 fig, 8 ref.

Descriptors: *Conjunctive use, *Optimization, *Simulation analysis, *Model studies, *Computer models, Computer programs, Surface-groundwater relationships, Water levels, Water level fluctuations, Water utilization.
Identifiers: Watershed models, Arkansas River Valley (Colo).

A generalized digital computer program has been developed to simulate the conjunctive use of surface and groundwater in a stream-aquifer system. The model was adapted to the 25-mile reach of the Arkansas River Valley between La Junta and Las Animas, Colorado. Water table fluctuations in the aquifer and water exchange between the river and aquifer were studied with time. Variables considered include water applied within the area as irrigation; recharge due to precipitation; withdrawals from the aquifer by pumps and phreatophytes; and the geologic parameters of permeability, storage coefficient, bedrock elevation, and initial amount of water in storage. A comprehensive hydrologic evaluation of the study reach by the U. S. Geological Survey provided data used in verification of the model. Only a 12 month period from Oct 1, 1963, to Oct 1, 1964, was simulated, but experience with the model indicated satisfactory verification was obtained. The modeling of groundwater systems with digital computers provides flexibility, rapid analyses and an economical approach. Use of digital computer models in making administrative decisions and for optimization of the water resources is expected. (Knapp-USGS)
W70-00054

THE MECHANICS OF SURFACE RUNOFF,
Florida Univ., Gainesville. Dept. of Bioenvironmental Engineering.
For primary bibliographic entry see Field 02E.
W70-00055

THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering; and Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
James A. Liggett, and David A. Woolhiser.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 117-126, 1967. 10 p, 4 fig, 6 ref.

Descriptors: *Mathematical studies, *Rainfall-runoff relationships, *Runoff forecasting, *Unit hydrographs, *Routing, Hydrograph analysis, Synthetic hydrology, Overland flow, Channel flow, Streamflow forecasting.
Identifiers: *Watershed models, Kinematic wave theory.

The runoff process is extremely complex and cannot be described mathematically now or in the foreseeable future. The shallow water equations provide the closest description available, but the solution to these nonlinear equations appears to be too complex to gain general popularity, at least as far as the small drainage area is concerned. (The river problem seems to be easier to describe by data input to standard programs.) However, solutions to the shallow water equations provide insight into the physical process and aid in evaluating less complex models. The shallow water equations have indicated the important parameters in the overland flow problem. They indicate the degree of approximation in the easier kinematic wave solution. In a like manner they can indicate the strengths and weaknesses of any other method. Many aspects of the runoff process are stochastic. For example the exact stream or rivulet pattern can probably never be described deterministically. Also because the

input to a hydrologic system (rainfall) is stochastic, the output (streamflow) can only be described in terms of its probability laws. However, it is reasonable to separate and study those parts of the process that are deterministic for these are the components subject to control by engineering works or agricultural practices. (Knapp-USGS)
W70-00056

WATERSHED HYDRAULICS IN THE LABORATORY,
Missouri Univ., Rolla. Dept. of Civil Engineering.
Terence E. Harbaugh.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 500-513, 1967. 14 p, 5 fig, 19 ref.

Descriptors: *Model studies, *Hydraulic models, *Rainfall-runoff relationships, Routing, Time of concentration, Overland flow, Unit hydrographs, Time lag, Rainfall intensity.
Identifiers: Watershed models.

Laboratory facilities are basic ingredients in the understanding of the hydromechanic behavior of natural watersheds. The significant variables which influence time of concentration, time to equilibrium, time to peak, lag time, etc., are readily observable, thus providing an insight into the hydromechanic behavior of watersheds. This paper is devoted to a discussion of the characteristics of the time distribution of runoff (hydrography) with comments on lag time, time to peak, and other characteristics time responses of watersheds. Various definitions concerning the concept of time of concentration exist in hydrologic literature. Its general definition as the time it takes a drop of water to travel from the uppermost part of the watershed to the outlet is shown to be in direct contradiction to its definition as the time it takes a watershed to attain maximum discharge when subjected to a constant intensity rainfall. (Knapp-USGS)
W70-00065

PREDICTION OF SOIL AND WATER LOSSES,
Agricultural Research Service, Tifton, Ga. Soil and Water Conservation Research Div.; and Agricultural Research Service, Athens, Ga. Soil and Water Conservation Research Div.
Adrian W. Thomas, and John R. Carreker.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 514-523, 1967. 10 p, 1 fig, 10 tab, 12 ref.

Descriptors: *Water loss, *Soil erosion, *Consumptive use, *Evapotranspiration, Hydrologic budget, Water balance, Statistical methods, Regression analysis, Weather, Climates, Erosion, Rainfall-runoff relationships, Forecasting, Souteast U.S., Coastal plains.
Identifiers: Southern Coastal Plain.

Methods are presented for estimating water loss and consumptive use in the Southern Coastal Plain. Soil and water losses were measured from two fallow plots during a 7-yr period, 1960-1966. The average rainfall of 48.53 inches had an average EI value of 373, which was close to the long-time average of 350. The plots were on Tifton loamy sand with 3% slope, 83 ft in length and 1/20 acre in size. A stepwise regression analysis of rainfall parameters was made on a storm and annual basis for soil and water losses. For the storm basis, EI explained 52% of the variation of soil loss. A maximum percentage of 66% was found with 14 parameters, and an equation was written with 6 parameters explaining 64% of the variation in soil loss. For the annual basis, the maximum 30 min intensity explained 82% of the variation for soil loss. An equation was written with 5 parameters that explained 97% of the variation in soil loss. The kinetic energy explained 63% of the variation of water loss for the storm basis. A maximum percentage of 71 was obtained from all the parameters; however, 5 parameters gave an equation for predicting water loss with 69% of the variation explained. For the annual basis, the maximum 30-min intensity explained 79% of the variation in water loss, and a prediction equation with 5 parameters was written that explained 96% of the variation. These prediction equations should be helpful in planning conservation practices in the Southern Coastal Plain. (Knapp-USGS)
W70-00066

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02F.
W70-00204

WINTER CIRCULATION IN THE GULF OF ALASKA,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-00220

THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02L.
W70-00223

VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
Ministry of Works, Napier (New Zealand).
P. J. Grant.
J Hydrol, New Zeal, Vol 7, No 2, p 124-135, 1968. 12 p, 2 fig, 6 tab, 14 ref.

Descriptors: *Droughts, *Rainfall, *Climatology, Statistical methods, Weather, Precipitation (Atmospheric), Runoff forecasting, Infiltration, Rainfall-runoff relationships.
Identifiers: *New Zealand, Rainfall frequency, Rainfall effectiveness index.

Daily rainfall frequencies in New Zealand were analyzed using consecutive-year plots and cumulative-departure curves. It is shown that since the end of the 19th century there have been pronounced periodic changes in the frequencies of the larger daily rains. In spring, summer and autumn - winter was not analyzed in detail periodic mean rainfall, since 1890, is positively related to both frequency and percentage contribution of rains greater than 1.50 inches. Mean periodic rainfall effectiveness (R.E.) indices are presented. Abrupt decreases of R.E., or increases in drought severity, occurred in spring and summer during 1905-6, and in autumn about 1911. A further abrupt increase in drought severity occurred in spring about 1920. In summer, the most droughty period of this century was 1946-58; for autumn the current period since 1958 is the most droughty. Some of these changes of R.E. probably have practical significance, especially in relation to tree growth and some aspects of streamflow. The connection between frequency changes of the larger rains and changes of atmospheric circulation is briefly discussed. (Knapp-USGS)
W70-00256

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
W. C. Boughton.
J Hydrol, New Zeal, Vol 7, No 2, p 75-100, 1968. 26 p, 9 fig, 8 tab, 20 ref, 1 append.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Mathematical models, *Simulation analysis, Computer programs, Digital computers, Hydrograph analysis, Synthetic hydrology, Hydrologic budget, Water balance, Evapotranspiration, Water storage, Infiltration.
Identifiers: Watershed models.

The development of mathematical catchment models from past studies of catchment water balance is reviewed. The structure and operation of a catchment model which uses daily rainfalls to estimate daily volumes of runoff is described. A steepest-ascent method for evaluating variables in the model is described and the results obtained with the model on 5 catchments in New Zealand are reported. Computer program listings and instructions for use of the model are included. The basis of the model is a water balance between input as rainfall; output as evapotranspiration, runoff, and infiltration; and change in storage. The model simulates continuous catchment behavior, in drying as well as runoff, rather than simulating only storage-delay behavior. (Knapp-USGS)
W70-00257

2B. Precipitation

ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
For primary bibliographic entry see Field 02A.
W70-00037

THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
Technion - Israel Inst. of Tech., Haifa. Hydraulic Lab.
For primary bibliographic entry see Field 07B.
W70-00039

WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1968.
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 07C.
W70-00138

ECOLOGICAL EFFECTS OF WEATHER MODIFICATION: A PROBLEM ANALYSIS.
Michigan Univ., Ann Arbor. Dept. of Resource Planning and Conservation.
For primary bibliographic entry see Field 06G.
W70-00140

THE ROUND TURBULENT JET IN A CROSS WIND,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 08A.
W70-00154

VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
Ministry of Works, Napier (New Zealand).
For primary bibliographic entry see Field 02A.
W70-00256

2C. Snow, Ice, and Frost

COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
Geological Survey of Canada, Calgary (Alberta).
Nathaniel W. Rutter.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 991-999, Aug 1969. 9 p, 8 fig, 2 tab, 18 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Glacial drift, *Stratigraphy, Ice, Movement, Rheology, Sediments, Deposition (Sediments).
Identifiers: Glacier surges, Moraines.

A Neoglacial moraine of Bighorn Glacier, St. Elias Mountains, Yukon, probably formed by a surging glacier, and a Neoglacial normal moraine of nearby Grizzly Glacier were studied. Surficial deposits and erosional features were mapped. Fabric analyses were done in till at 5 sites in each moraine. Samples

were subjected to laboratory lithologic and texture analyses. The Bighorn (surge) moraine is a thin, discontinuous, irregular mantle till, but including ice-contact stratified material. Lateral moraines show subdued ridges marking the upper limit of glaciation. Ground moraine of the Grizzly (normal) glacier is an irregular, continuous, thick mantle, mostly till and ice-contact stratified material. Upper ice limits are marked by prominent ridges. Rocks of similar lithologies within the till are concentrated in bands parallel to glacier flow. Stones in till of the Grizzly moraine have strong preferred orientation roughly in the direction of glacier flow. In the Bighorn moraine, rocks in till are weakly oriented. Where orientation is apparent, it is not necessarily in the flow direction. For the size fraction finer than 2 mm, Bighorn till is coarser than Grizzly till although the bedrock terrain is similar. These differences are useful in distinguishing moraines of normal and surging glaciers. (Knapp-USGS)
W70-00007

OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
A. D. Stanley.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 819-830, Aug 1969. 12 p, 4 fig, 2 tab, 22 ref.

Descriptors: *Glaciers, *Flow, *Surges, Rheology, Ice, Movement, Regimen, Melting, Water, Climates, Temperature.
Identifiers: *Canada, *Yukon Territory, Steele Glacier, Glacier surges.

For part of 1966, Steele Glacier in the Icefield Ranges, Yukon Territory, Canada, made a spectacular advance at a rate exceeding 500 m per month. The main part of the surge continued for two yr, but by early 1968 the advance had slowed to less than one tenth of the maximum rate. For most of the 35-km length of the main trunk the surface was a chaotic jumble of ice blocks, spires, and pinnacles, but large structures outlined by surface moraine were preserved. Most of these structures had been displaced 8 km by August 1967, irrespective of their location. Preliminary measurements indicate structures were displaced similar distances down the length of the glacier and suggest that most of the glacier moved forward as a block. The surge has not been correlated with any local earthquake activity, and there is no evidence for a short-term climatic change. The movement is considered to result from critical dynamic conditions within the glacier, possibly facilitated by increased amounts of water along the ice-bedrock contact. (Knapp-USGS)
W70-00009

ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
Princeton Univ., N.J. Dept. of Geology.
John T. Hollin.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 903-910, Aug 1969. 8 p, 2 fig, 39 ref. NSF Grant No GA-3920.

Descriptors: *Glaciers, *Flow, *Surges, *Antarctic, *Paleoclimatology, Pleistocene epoch, Quaternary period, Movement, Ice, Rheology, Melting, Water, Climates, Temperature, Weather, Albedo.
Identifiers: *Ice caps, Paleoglaciology, Antarctic ice cap, Ice cap surges, Glacier surges.

If they had occurred, ice-sheet surges would have caused sea-level rises of up to 50 m from Gondwanaland and 20 m from Antarctica. The rises would have taken 100 yr or much less, and the subsequent falls would have taken 50,000 yr or so, as the ice built up again. Such rises may explain the extensive and sharp coal - marine shale contacts in the Carboniferous cyclothems. The chief rival explanation for these contacts is sudden subsidence. Tests should show (1) if such contacts are better correlated with periods of glaciation or with areas of tectonic activity, (2) how extensive the contacts really are, (3) if there is any evidence of erosion during sea-level falls, (4) if the amplitudes and periods of the cycles fit surges or subsidence, (5) how fast the submergences were, and (6) if any coolings began at the contacts. Wilson suggests that in the Pleistocene the surge coolings were sufficient to trigger the northern ice ages. If so, interglacial pollen profiles should show rapid but temporary marine transgressions beginning at the break of climate. Evidence suggesting such transgressions occurs in England and the United States, but is still insufficient to disprove explanations such as local downwarping. There is no evidence yet for surges in Wisconsin or Post-glacial time. There is some evidence that the Antarctic Ice Sheet is currently building up, but this could be a response to a Post-glacial accumulation increase rather than the prelude to a surge. (Knapp-USGS)
W70-00013

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
Victoria Univ., Wellington (New Zealand). Dept. of Chemistry.
A. T. Wilson.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 911-918, Aug 1969. 8 p, 10 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Antarctic, *Paleoclimatology, Pleistocene epoch, Quaternary period, Movement, Ice, Rheology, Melting, Water, Climates, Temperature, Weather, Albedo.
Identifiers: *Ice caps, Paleoglaciology, Antarctic ice cap, Ice cap surges, Glacier surges.

Surges in ice masses of glacier size are now well accepted in glaciology. There seems no reason why a similar phenomenon should not occur in bodies of ice as large as continental ice sheets. If a continental ice sheet surged into the sea it would have a considerable effect on world sea-level. This is proposed as the mechanism of past sea level fluctuations (cyclothems) of the Carboniferous and Tertiary. The effect of a surge of the Antarctic Ice Sheet on world climate is considered, with particular reference to the origin of ice ages. The requirements of an ice-age mechanism are discussed and it is concluded that a periodic surge of the Antarctic Ice Sheet, perhaps induced by a decrease in insolation to the south polar region, has all the requirements of an ice-age inducing mechanism. In particular, any oscillating system must have capacitance (storage) and impedance (resistance). It is not easy to find a system in nature with a sufficiently long period of oscillation. However, the build up of ice on Antarctica would provide a sufficiently slow charging of storage, and the ice sheet itself would provide the storage to yield a system of long enough period. It is proposed that when the Antarctic Ice Sheet surges, a large ice shelf is produced which increases the albedo of the Earth. The resulting cooling leads to the formation of secondary ice sheets in the Northern Hemisphere, which in turn leads to a further increase in albedo and further cooling. The break up of the ice shelf and its replacement by ocean would lead to a large decrease in the Earth's albedo. The resulting warming would lead to the rapid melting of the subsidiary ice sheets and the ending of the ice age. (Knapp-USGS)
W70-00014

INITIATION OF GLACIER SURGES,
Scott Polar Research Inst., Cambridge (England).
G. De Q. Robin.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 919-928, Aug 1969. 10 p, 6 fig, 11 ref.

Descriptors: *Glaciers, *Flow, *Surges, Movement, Ice, Rheology, Melting, Water, Climates, Temperature, Regimen, Stress, Strain.
Identifiers: Glacier surges.

Three types of instability leading to glacier surges have been suggested, namely stress instabilities, temperature instabilities, and water-film instabilities. Evidence of approximately equal volumes of ice being involved in repeated surges of the same glacier favors stress instabilities as the most likely cause. Since for a steady rate of discharge a section of a glacier undergoing extending flow tends to be of the order of thirty meters thicker than for compressive flow under otherwise similar conditions, it is suggested that surges originate when the glacier flow switches between these two modes of flow. In the accumulation zone of a glacier, a surge would be triggered off by a change from extending to compressive flow over a length of the glacier. If the volume of ice and movement velocities involved are sufficiently large this could lead to repeated surging, although a tendency to stability appears to exist. In the ablation zone, glacier acts as a rigid, sliding dam and increases ice thickness upstream. In this zone, if the volume discharge of the glacier increases beyond a critical limit that depends on bedrock topography, it would initiate a surge. (Knapp-USGS)
W70-00015

WATER LUBRICATION MECHANISM OF GLACIER SURGES,
Northwestern Univ., Evanston, Ill. Dept. of Materials Science; and Army Terrestrial Sciences Center, Hanover, N.H.
J. Weertman.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 929-942, Aug 1969. 14 p, 2 tab, 44 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Floating, Melting, Water, Ice, Movement, Rheology, Temperature, Climates, Regimen, Stress, Strain.
Identifiers: Glacier surges.

A theory of glacier surges is reviewed and amplified. This theory is based on the premise that a glacier surge occurs when a water layer at the base of a glacier attains a thickness sufficient to drown the obstacles in the bed that offer the greatest hindrance to sliding. In the case of a glacier bed which is very smooth, the stress concentrations in the vicinity of obstacles in the bed are so high that the power-law creep equation is no longer valid. As a consequence, the size of the controlled obstacles is reduced and thus a surge is more likely to occur. (Knapp-USGS)
W70-00016

THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
Monsanto Co., St. Louis, Mo.
Lawrence E. Nielsen.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 955-961, Aug 1969. 7 p, 6 fig, 9 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Rheology, Ice, Movement, Stress, Strain, Viscosity, Regimen, Temperature, Stability, Plasticity, Mechanical properties.
Identifiers: *Glacier surges, Powder flow, Ice dams, Stagnant ice.

To explain glacier surges, it is assumed that a stagnant ice block or dam develops in the lower regions of a glacier. Ice gradually builds up above the dam while the dam itself becomes thinner by ablation. Eventually the upper end of the stagnant ice block crumbles from the force of the ice above it, and much of the glacier is changed from a state of compression to one of tension. The breaking of the ice dam results in the glacier rapidly becoming broken into a mass of blocks or powdered ice. The apparent viscosity of the broken-up glacier is much less than that of bulk ice, so high velocities of flow are possible, and a phenomenon similar to a mud flow results. This theory explains why some glaciers repeatedly surge yet appear stagnant between surges. The broken-up appearance of surging glaciers and the delayed surging of tributaries are explained. Additional substantiating observations on several of these phenomena are presented. (Knapp-USGS)
W70-00017

DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
McGill Univ, Montreal (Quebec). Dept. of Metallurgical Engineering; and McGill Univ., Montreal (Quebec). Dept. of Geography.
John J. Jonas, and Fritz Muller.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 963-968, Aug 1969. 6 p, 6 fig. 6 ref. Canada Defense Res Board Grant No 9511-73.

Descriptors: *Ice, *Rheology, *Flow, *Stress, Plasticity, Viscosity, Melting, Freezing, Crystal growth, Shear stress, Strain, Mechanical properties.
Identifiers: Ice deformation, Dynamic recrystallization.

By means of transparent plastic dies, cylindrical samples of single crystal and polycrystalline ice were extruded into rods of one quarter the original cross-section area. The deformation was carried out at -5 deg C and a mean strain rate of about .01/s. With the aid of polarized light, the formation of cracks and the occurrence of dynamic recrystallization were studied. The experiments of Steinemann, and more recent results in metals suggest that, during such plastic flow, two types of dynamic recrystallization are involved. At low strain rates, the recrystallization is periodic, leading to rapid increases in strain rate at constant applied stress; at higher strain rates, the recrystallization is continuous and the strain rate is constant. The possibility that dynamic recrystallization of the periodic type is associated with glacier surges is discussed. (Knapp-USGS)
W70-00018

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968: A SUMMARY,
Geological Survey, Tacoma, Wash.
Mark F. Meier.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 987-989, Aug 1969. 3 p.

Descriptors: *Glaciers, *Flow, *Surges, *Rheology, *Conferences, Reviews, Regimen, Melting, Movement, Ice, Physical properties, Mechanical properties, Plasticity, Viscosity, Climates, Temperature.
Identifiers: *Glacier surges.

A symposium on glacier surges was held in St. Hilaire, Canada, September 1968. As a result of this symposium certain points appear now to be quite well established. Many surging glaciers exist and many types of glaciers surge. However, no surging glaciers which are below freezing at their beds have yet been identified. Surging glaciers occur only in certain limited areas, and these areas apparently are not related to climate, so that some property at the glacier bed must be a necessary condition for a glacier surge. Most, if not all, surging glaciers surge repeatedly and with a period which is reasonably constant. The cause of surges apparently involves drastic changes in bed friction which might be related to water at the bed, either as a thin film or in isolated pockets. However, some very important questions are still outstanding. The temperature regimes in surging glaciers are still unknown. Whether there is a continuous spectrum of behavior from surging glaciers to ordinary 'normal' glaciers, or whether surging glaciers are a class apart, is still an open question. The relation of surging glacier periodicity to mass balance changes or climatic histories cannot yet be defined. The exact role of water at the bed as well as the proper concept of bed roughness have not yet been defined adequately. It was not possible to define glacier surges in a completely satisfactory way, partly because different glaciologists place emphasis on different aspects of this interesting phenomenon. (Knapp-USGS)
W70-00019

GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
Washington Univ., Seattle. Dept. of Electrical Engineering.
A. E. Harrison.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 1001-1007, Aug 1969. 7 p, 7 fig, 6 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Alaska, Surveys, Aerial photography, Climates, Temperature, Melting, Ice, Rheology, Movement, Regimen.
Identifiers: *Glacier surges, Muldrow Glacier (Alaska).

Photographic evidence suggests that a normal wave of ice was progressing down the Muldrow Glacier prior to the occurrence of the surge in 1956. The ice thickening began before 1947, with a wave motion of about 250 m per yr between 1948 and 1952. Progress may have slowed after 1952 because the bulging lateral margin had not reached the McGonagall Pass by 1954. The ice opposite McGonagall Pass thickened spectacularly after 1954 and a lateral ice cliff extended at least 1.6 km beyond McGonagall Pass when the ice began its surge movement in 1956. Aerial photographs taken after the surge ended in 1957, plus photographs from the ground in the vicinity of the bend in the Muldrow before surge motion reached that area in 1956, suggest that several small tributaries were also rejuvenated just before the surge occurred. These observations point to the possibility of climatic synchronism in the Alaskan Range and the southern ranges of North America. (Knapp-USGS)
W70-00020

RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
Defense Research Establishment Ottawa (Ontario). Geophysics Section.
G. Hattersley-Smith.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 883-889, Aug 1969. 7 p, 4 fig, 10 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Surveys, Aerial photography, Movement, Ice, Rheology, Melting, Water, Climates, Temperature, Regimen.
Identifiers: *Ellesmere Island, Glacier surges.

Air photographs show that the Otto Glacier in northwestern Ellesmere Island started to surge sometime between 1950 and 1959, with the result that the terminus advanced about 3 km as a floating ice tongue. Maps prepared from the 1959 photographs and from additional photographs taken in 1964 show a further advance of 2-3 km. Information from a subglacial relief map of the terminal part of the glacier, constructed from the results of radio-depth sounding over the glacier in 1966, may have a bearing on the mechanism of glacier surges. Other glaciers in northern Ellesmere Island show features indicative of past surges. (Knapp-USGS)
W70-00021

WHAT ARE GLACIER SURGES,
Geological Survey, Tacoma, Wash. Water Resources Div.
Mark F. Meier, and Austin Post.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 807-817, Aug 1969. 11 p, 4 fig, 1 tab, 7 ref.

Descriptors: *Glaciers, *Flow, *Surges, Cryology, Ice, Movement, Regimen, Rheology, Surveys, Climates, Temperature, Glacial drift, Sediments.
Identifiers: *Surging glaciers, Glacier surges.

A total of 204 surging glaciers has been identified in western North America. These glaciers surge repeatedly and probably with uniform periods (from about 15 to greater than 100 yr.). Ice flow rates during the active phase may range from about 150 m/yr to more than 6 km/yr, and horizontal displacements may range from less than 1 to more than 11 km. Ice reservoir and ice receiving areas can be defined for surging glaciers, and the reservoir area does not necessarily coincide with the accumulation area. Glaciers, of all shapes, sizes, and longitudinal profiles can surge, and no unusual 'ice dams' or bedrock constrictions are evident. Surges occur in many different climatic, tectonic, and geologic environments, but only certain limited areas (mainly in the Alaska, eastern Wrangell, and St. Elias mountains). Three types of surging glaciers are defined: (1) large to moderate-sized glaciers with large displacements and very fast flow, (2) large to moderate glaciers with moderate displacements and flow rates, and (3) small glaciers with small displacements and moderate to fast flow rates. All three types involve an inherent instability which is self-triggered at regular intervals, but with Type 1 surges an additional (unknown) mechanism produces the very high flow rates. (Knapp-USGS)
W70-00022

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
American Geographical Society, New York.
William O. Field.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 831-839, Aug 1969. 9 p, 8 fig, 7 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Alaska, Rheology, Ice, Movement, Regimen, Melting, Water, Climates, Temperature.
Identifiers: *Glacier surges, Glacier Bay (Alaska).

Nine glaciers in Glacier Bay, in southeastern Alaska, and three others within a radius of 60 km have been known to surge in the last 60 yr. Of these, seven have surged during the 1960's. The surges of three of them, the Tyeen, Rendu, and Carroll, are discussed in this paper. Each glacier has surged one or more times previously. The course of each surge has been documented by photography but there has been no study of the regimens of these glaciers. The distribution in time and space of these and other surges in the Glacier Bay area are discussed and it is suggested that there may be external factors which cause more surges during some periods than others. These relationships need to be correlated and analyzed. A program of future observations is suggested. (Knapp-USGS)
W70-00023

THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
Ohio State Univ. Research Foundation, Columbus. Inst. of Polar Studies.
Colin Bull.
Canadian J Earth Sci, Vol 6, No 4 Part 2, p 841-843, Aug 1969. 3 p, 1 fig, 4 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Alaska, Rheology, Ice, Movement, Melting, Regimen, Water, Climate, Temperature.
Identifiers: *Sherman Glacier (Alaska), Glacier surges.

One-third of the ablation area of the Sherman Glacier, Alaska, was covered by a debris sheet resulting from the 1964 Alaskan earthquake. Subsequently observed changes in the mass balance and the movement regime of the glacier lead to the prediction of a surge-type advance in the near future. (Knapp-USGS)
W70-00024

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
American Geographical Society, New York.
Eva V. Horvath, and William O. Field.
Canadian J Earth Sci, Vol 6, No 4 Part 2, p 845-851, Aug 1969. 7 p, 1 tab, 62 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Bibliographies, *Reviews, Rheology, Ice, Movement, Regimen, Melting, Water, Climates, Temperature.
Identifiers: *Glacier surges, Surging glaciers.

Reported glacial surges in North America are listed and references to surges are compiled. Additional

general discussions of surge phenomena are also listed as well as reports of surges in other parts of the world. (Knapp-USGS)
W70-00025

SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
Innsbruck Univ. (Austria).
Herfried C. Hoinkes.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 853-861, Aug 1969. 9 p, 6 fig, 2 tab, 20 ref.

Descriptors: *Glaciers, *Flow, *Surges, Rheology, Ice, Movement, Regimen, Melting, Water, Climates, Temperature.
Identifiers: *Austria, Tyrol, Vernagtferner, Surging glaciers, Glacier surges.

The history of catastrophic advances of Vernagtferner (Otztal Alps, Tyrol) is described briefly. To all appearances these advances were surges. They occurred periodically with a short active advance and a much longer time of retreat; the whole cycle lasted on an average 82 yr. The mode of flow of the ice changed typically; speed during surges increased more than one order of magnitude with heavy crevassing. Dimensions of advance and of retreat were much longer than known from other glaciers in the area. (Knapp-USGS)
W70-00026

EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau und Erdbau.
H. Rothlisberger.
Canadian J Earth Sci, Vol 6, No 4 Part 2, p 863-865, Aug 1969. 3 p, 1 fig, 2 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Debris avalanches, Rheology, Ice, Movement, Regimen, Melting, Water, Climates, Temperature, Reviews.
Identifiers: *Switzerland, Alps, Glacier surges.

The climatic and glacial history of two locations in the central Alps has been discussed by Zoller et al. (1966). A brief outline of one aspect of this work is given. In order to explain some peculiar lateral moraines which are only 30-50 m above the valley floor, and a thick layer of presumably glacial deposit down valley, a surge has been postulated, which was triggered by a rock avalanche onto the glacier. (Knapp-USGS)
W70-00027

SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
Stockholm Univ. (Sweden). Dept. of Physical Geography.
V. Schytt.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 867-873, Aug 1969. 7 p, 3 fig, 15 ref.

Descriptors: *Glaciers, *Flow, *Surges, Surveys, Regimen, Movement, Ice, Rheology, Melting, Water, Climates, Temperature.
Identifiers: *Spitsbergen, Glacier surges.

Between 1936 and 1938 a great amount of ice flowed out from Sorfonna (the South Ice) on the south coast of Nordaustlandet. What had been an even slope of the ice sheet in 1936 developed into a badly crevassed glacier tongue by 1938, pushing approximately 20 km out to the sea along a front of 30 km. The new glacier was named Brasvellbreen, which in fact means 'rapid growth glacier', but because of World War II, no field investigations could be carried out until more than 10 yr after its discovery. The majority of glaciers in eastern Vestspitsbergen have retreated during this century a few, however, have advanced considerably during short periods and taken part in the general retreat during the rest of the time. Air photographs from 1024, 1938, 1956, and 1957 show that most of the ice edge in western Nordaustlandet has remained stable Sore Franklinbreen, however, has shown large oscillations. The glaciers in the area belong to the sub-polar type, i.e. the 10-m ice temperature in the ablation area remains at about 8-10 deg below zero throughout the yr, whereas the 10-m firn temperature in the accumulation area is at or very near freezing point. There are large variations in accumulation conditions from one Spitsbergen glacier to the other. The west coast of Vestspitsbergen is under the influence of mild and wet air masses from the Atlantic- the east coast is far more continental. The Nordaustlandet ice caps, on the other hand, receive most of their accumulation with winds from the Barents Sea. Annual net balance values of 80-120 g/sq cm are quite common on the eastern slopes of Austfonna (the East Ice), values of 70-90 g/sq cm have been observed along the crest of Sorfonna, and it is likely that large parts of the accumulation area of Brasvellbreen itself receives an annual net balance of between 50 and 90 g/sq cm. (Knapp-USGS)
W70-00028

GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
Museum of Natural History, Reykjavik (Iceland). Dept. of Geology and Geography.
Sigurdur Thorarinsson.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 875-882, Aug 1969. 8 p, 8 fig, 1 tab, 7 ref.

Descriptors: *Glaciers, *Flow, *Surges, Movement, Ice, Rheology, Surveys, Melting, Water, Climates, Temperature, Regimen.
Identifiers: *Iceland, Bruarjokull, Glacier surges.

The glacier surges that have occurred in Iceland since 1890 are listed, and the largest ones, those of Bruarjokull in 1890 and 1963-64, are described. The glacier area affected by the surges of Bruarjokull is about 1,400 sq km, the volume of ice and firn affected is about 700 sq km, and the total advance of the glacier front is 8-10 km. The maximum rate of advance of the glacier front in 1963 was at least 5 m/hour. Bruarjokull's surges seem to occur with an interval of 70-100 yr. (Knapp-USGS)
W70-00029

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
McGill Univ., Montreal (Quebec).
Fritz Muller.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 891 894, Aug 1969. 4 p, 2 fig, 3 ref.

Descriptors: *Glaciers, *Flow, *Surges, Movement, Ice, Rheology, Melting, Water, Climates, Temperature, Regimen.
Identifiers: *Canada, *Axel Heiberg Island, *Glacier surges.

The lower part of the Good Friday Glacier on Axel Heiberg Island, N.W.T., started, sometime between 1952 and 1959, a period of markedly increased movement associated with a frontal advance of over 2 km, which showed clearly some of the features attributed to a glacier surge, while others were lacking. Such border cases merit special attention. (Knapp-USGS)
W70-00030

GLACIER SURGES IN WEST SPITSBERGEN,
Norsk Polarinstitutt, Oslo.
Olav Liestol.
Canadian J Earth Sci, Vol 6, No 4 Part 2, p 895-897, Aug 1969. 3 p, 2 fig, 2 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Melting, Water, Movement, Ice, Rheology, Climates, Temperature, Regimen.
Identifiers: *West Spitsbergen, Glacier surges.

Surges constitute a common form of glacier advance in Spitsbergen. The fastest movement observed is that of the Negri Clacier, with an advance of about 12 km in less than a yr. Observations on the Finsterwalder Glacier indicate that the ice flow is too small to maintain a steady-state slope. At intervals, of the order of 100 yr, the glacier will balance this build-up by surging. A small surging glacier in the Dickson Valley has a sheet of refrozen meltwater in the front. This refrozen meltwater is possibly generated by the surge. (Knapp-USGS)
W70-00031

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
O. H. Loken.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 899-901, Aug 1969. 3 p, 1 fig, 2 ref.

Descriptors: *Glaciers, *Flow, *Surges, Movement, Ice, Rheology, Melting, Water, Regimen, Climates, Temperature, Streamflow.
Identifiers: *Canada, *Baffin Island, Glacier surges.

The morphology of the Barnes Ice Cap is studied on the basis of detailed topographic maps. Two anomalous areas characterized by an apparent excess of mass at lower elevations and a similar deficit at higher altitudes are identified. Local surges affecting these two parts of the ice cap could have caused this mass distribution. The moraine patterns adjacent to the ice cap show that the ice margin in the two areas has recently advanced in distinct contrast to the general retreat in adjacent areas. (Knapp-USGS)
W70-00032

PROPAGATION OF GLACIER SURGES,
Scott Polar Research Inst., Cambridge (England); and Cambridge Univ. (England). Cavendish Lab.
G. De Q. Robin, and P. Barnes.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 969-977, Aug 1969. 9 p, 6 fig, 11 ref.

Descriptors: *Glaciers, *Flow, *Surges, Stress, Strain, Plasticity, Viscosity, Melting, Water, Ice, Freezing, Shear stress, Temperature, Mechanical properties, Velocity, Friction.
Identifiers: *Glacier surges, Ice deformation.

Propagation of glacier surges has been discussed in terms of stresses acting in the three major zones of the surge. The steeply sloping front of a surge appears sufficient to explain the thickening of a glacier and the rise in velocity of ice motion which takes place across this zone in terms of accepted stress-strain rate data for ice. Explanation of the high velocities which occur in the next zone in spite of little change in the available shear stress is more difficult, but the experimental results of Barnes and Tabor on ice close to the melting point appear to offer an explanation of the unusually high rates of flow. In the tensile zone, where velocities slow down, the net lowering of the glacier surface after the surge has passed is explained in terms of the depth of crevassing and easier flow of ice at melting point when under tensile and shear stresses. (Knapp-USGS)
W70-00033

A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
Forest Service (USDA) Pacific Northwest Forest and Range Experiment Station, Juneau, Alaska.
D. N. Swanston.
Arctic 1969, 22 (1):25-33. 4 fis (1 map), 8 ref.

Descriptors: *Glaciation, *Glacial soils, *Glacial till, *Moraines, Geomorphology, Pleistocene epoch, Alaska.
Identifiers: Glacial geology, Glacial sequences, Regional glaciation, Recessional moraines, Glacial advance, Southeast Alaska.

Evidence of two late-Pleistocene glacial advances is exposed in Maybeso Creek valley. A cemented 'younger' till with a shallow weathered zone directly overlies a thoroughly leached and partly oxidized 'older' till. The younger till was deposited by a glaciation of regional extent representing the last major glacial advance of classical Wisconsin age in southeast Alaska. The older till may also represent a regional glaciation, tentatively correlated with an intermediate to early-late Wisconsin age. Four recessional moraines in the valley record dying pulsations of the glaciation that deposited the younger till during the early part of the late glacial interval preceding the Hypsithermai. (Author)
W70-00166

RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
Geological Survey, Menlo Park, Calif.
Donald E. White.
J Geophys Res, Vol 74, No 22, p 5191-5201, Oct 15, 1969. 11 p, 7 fig, 1 tab, 12 ref.

Descriptors: *Geothermal studies, *Heat flow, *Snowfall, *Surveys, Springs, Thermal water, Thermal radiation, Winds, Air temperature, Mapping, Contours, Computers, Infrared radiation.
Identifiers: *Yellowstone Park (Wyo), Heat-flow survey.

Individual heavy snowfalls were utilized for a rapid low-cost means of measuring the total heat flows in hot spring areas of Yellowstone Park, Wyoming. The method consists of mapping on a suitable base the contacts between snow-covered and snow-free ground after a favorable snowfall (heavy snow, brief duration, air temperature near 0 deg C). Each mapped contact as time elapses after a specific snowfall, is a heat flow contour representing a decreasing rate of flow. Heat flow contacts mapped to date vary from 450 to 5500 micro cal/sq cm sec, or 300 to 3700 times the world average of conductive heat flow. Thermal anomalies from infrared imagery are similar in shape to heat-flow contours of a test area near Old Faithful Geyser of the Yellowstone Park. (Gabriel-USGS)
W70-00201

A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
Centre National de la Recherche Scientifique, Grenoble (France). Laboratoire de Glaciologie.
Louis A. Lliboutry.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 943-953, Aug 1969. 11 p, 5 fig, 1 tab, 17 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Friction, Movement, Ice, Rheology, Stress, Strain, Viscosity, Melting, Water, Regimen, Climates, Temperature.
Identifiers: Glacier surges.

Glacier surges may result (1) from the warming of a cold glacier, which follows an unusual snow cover, with the formation of a temperature basal layer, or (2) from the fact that two values of the sliding velocity correspond to a single value of the friction. As a rule, for increasing sliding velocities the friction goes through a maximum and next through a minimum. Thus for one value of the friction three values of the velocity, two stable ones and an unstable one, can exist. Since the derivative of the friction with respect to the sliding velocity may become negative, the coefficients in the perturbation equation may become infinite (their ratio remaining finite), and next negative. When a flood wave runs down a glacier, an area with a negative diffusion coefficient may appear. Then the profile of the wave is altered; it vanishes at the upper part of this area and swells beyond measure at the lower one. Factors which may limit the amplitude of this surge are pointed out. (Knapp-USGS)
W70-00221

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASI A),
Toronto Univ. (Ontario). Dept. of Geography.
Kenneth Hewitt.
Canadian J Earth Sci, Vol 6, No 4, Part 2, p 1009-1018, Aug 1969. 10 p, 2 fig, 1 tab, 71 ref.

Descriptors: *Glaciers, *Flow, *Surges, *Reviews, *Bibliographies, Alaska, Movement, Ice, Rheology, Temperature, Mountains, Climates, Melting, Water, Freezing.
Identifiers: *Karakoram, Yukon, Glacier surges.

The Karakoram and Alaska-Yukon region between them account for perhaps 90% of the known surging glacier events. While modern research and information is available for North America, the Karakoram, though often referred to, remains virtually unknown except in a very general sense. The prime aim of this paper is to collate all the information that is available for the Karakoram from the usually old and inaccessible documents where it is found. It establishes eleven instances of surges with reasonable certainty and the probability of many more. The rare instances of detailed description of the phenomena are quoted. A short discussion is given of the degree to which the information, and knowledge of the Karakoram environment, equate with various mechanisms put forward to explain surging glacier events. (Knapp-USGS)
W70-00222

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
Geological Survey, Tacoma, Wash.
Austin Post.
J Glaciol, Vol 8, No 53, p 229-240, 1969. 12 p, 5 fig, 1 tab, 13 ref.

Descriptors: *Glaciers, *Surges, *Regimen, *Alaska, *Surveys, Climates, Cryology, Ice, Mountains, Rheology, Frequency, Precipitation (Atmospheric), Flow, Friction, Heat flow.
Identifiers: *Surging glaciers, Glacial surges.

In western North America 204 surging glaciers have been identified by aerial photographic observations. These glaciers exhibit intense crevassing and rapid ice displacements during surges, or distinctive surface features which have resulted from past surges. Distribution of these unusual glaciers is not random throughout the glacierized areas, as they occur only in the Alaska Range, eastern Wrangell Mountains, eastern Chugach Mountains, Icefield Ranges, and the St. Elias Mountains near Yakutat and Glacier Bay. No surging glaciers have been identified in the Brooks Range, Kenai Mountains, west and central Chugach Mountains, west and central Wrangell Mountains, Coast Mountains, Rocky Mountains, Cascade Range, Olympic Mountains, or Sierra Nevada. No definite reason for this restricted distribution is apparent. Surging glaciers are found in maritime to continental and temperate to subpolar environments. Practically all physical forms of glaciers are represented. The restricted distribution does not relate to topography, bedrock type, altitude, orientation, or size of glacier. Some surging glaciers are associated with fault-related valleys, but neither recent faulting nor earthquakes have initiated surge activity. Possible causes for the limited distribution of surges are unusual bedrock roughness or permeability in certain areas, anomalously high groundwater temperatures, and abnormal geothermal heat flow. (Knapp-USGS)
W70-00239

HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
Wisconsin Univ., Madison.
John T. Scott, and Robert A. Ragotzkie.
ONR Contract 1202 (07). Task NR 387-022. Technical Report No 6, Department of Meteorology, University of Wisconsin, Oct, 1961. 5 p, 13 tab, 15 fig, 23 ref, 7 append.

Descriptors: *Heat budget, *Radiation, *Latent heat, *Advection, Conduction, Snow cover.
Identifiers: Heat storage, Lake Mendota.

The heat budget for Lake Mendota is evaluated for two winter seasons. Change in heat storage, radiation flux conduction and advection are determined separately for snow, ice and water where applicable. The general heat budget equation Rn= C+ E+ L is used where Rn is net radiation, C is change in heat storage and L is exchange of sensible heat between the surface and the air. It is observed that net radiation, air temperature and snow cover are the most important factors affecting the heat budget equation. With some improvement in the methods, the heat budget can be used as a check against instrumental techniques for determining sensible heat flux (L) because during winter, evaporation is often negligible for long cold periods. Seven distinct periods of the winter season are described using the heat budget data for the two years. (Upadhyaya-Vanderbilt)
W70-00317

2D. Evaporation and Transpiration

PREDICTION OF SOIL AND WATER LOSSES,
Agricultural Research Service, Tifton, Ga. Soil and Water Conservation Research Div.; and Agricultural Research Service, Athens, Ga. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02A.
W70-00066

CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
National Bureau of Standards, Washington, D.C.
W. G. Spangenberg, and W. R. Rowland.
The Physics of Fluids, Vol 4, No 6, p 743-750, June 1961. 10 fig, 9 ref.

Descriptors: *Convection circulations, *Convection currents, Thermal pollution, Cooling water, Evaporation.
Identifiers: *Schlieren photographs, Fluid depth effects, Temperature distribution, Columnar plunging, Surface deformation.

Schlieren photographs taken simultaneously from the top and side of a tank of water are here used to study convection currents induced by evaporative cooling. It is found that water from the cooled surface layer collects along lines producing thickened regions which become unstable and plunge in vertical sheets. Surface water then continues to flow downward through the sheets, reducing the cooled surface layer to a thin film. In top schlieren views the plunging regions sometimes appear straight, sometimes curved, and branched or terminated with no fixed pattern. The number of lines per unit area is a function of the cooling rate rather than the depth of the container. Reticulated surface patterns were observed only at particular cooling rates and columnar plunging occurred only on rare occasions. No distinctly different combination of conditions to differentiate between the causes of these different modes was evident. Numerical integration of the nonlinear temperature distribution in the cooled layer showed a critical Rayleigh number of 1193 when convective circulation started, and a Rayleigh number of 102 for maintaining an established uniform circulation. (Ross-Vanderbilt)
W70-00156

2E. Streamflow and Runoff

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-00001

ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-00004

FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN.
Corps of Engineers, Chicago, Ill.
For primary bibliographic entry see Field 04A.
W70-00008

FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA.
Corps of Engineers, Pittsburgh, Pa.
For primary bibliographic entry see Field 04A.
W70-00010

THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
International Atomic Energy Agency, Vienna (Austria); and Ministry of Natural Resources, Nairobi (Kenya). Dept. of Water Development.
For primary bibliographic entry see Field 07B.
W70-00035

DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
Ministry of Irrigation and Power, New Delhi (India).
K. C. Majumdar.
J Hydrol, Vol 8, No 3, p 303-322, Jul 1969. 20 p, 1 fig, 5 tab, 9 ref.

Descriptors: *Reservoir operation, *Streamflow forecasting, *Probability, Irrigation, Hydroelectric power, Water storage, Water management (Applied), Planning, Reservoir design, Computer programs, Statistical methods.
Identifiers: *India.

A method has been developed to determine the optimum storage capacity of a reservoir corresponding to different probabilities of the desired amount of water each year. The method considers a large number of random normal deviates to represent a simulated series of annual inflow data. For the purpose of determination of storage capacity of any dam, the probabilities of the reservoir fullness of emptiness were determined for different values of draft and storage capacities. These have been obtained by drawing 5152 simulated data and analyzing them in an IBM 1620 electronic computer. The results presented can be applied to any river basin of which annual runoffs obey the normal distribution law. A method of economically fixing the optimum storage capacity by taking into consideration the expected net return from the project is also indicated. (Knapp-USGS)
W70-00038

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
City Univ., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-00041

FLOOD PLAIN INFORMATION, WESTFIELD AND LITTLE RIVERS, WESTFIELD, MASSACHUSETTS.
Corps of Engineers, Waltham, Mass.
For primary bibliographic entry see Field 04A.
W70-00042

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES: PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
Geological Survey, Washington, D.C.
L. E. Young, and R. W. Cruff.
Geol Surv Water-Supply Pap 1686, 1967. 308 p, 20 fig, 2 plate, 4 tab, 13 ref.

Descriptors: *Flood forecasting, *California, *Rainfall-runoff relationships, Streamflow forecasting, Routing, Stage-discharge relations, Topography, Water storage.
Identifiers: Flood frequency, Klamath River Basin (Calif), Smith River Basin, Central Valley.

A method is presented for determining the probable magnitude of annual maximum floodflows for any recurrence interval between 1.2 and 50 years for any stream, gaged or ungaged, in and near the Klamath and Smith River basins, California. The area has been divided into 4 regions of differing flood-frequency characteristics. The flood-frequency relation is undefined in one of these regions - the flat Central Valley because of the lack of records for unregulated streams within its boundaries. The hydrologic basin characteristics having the most significant effect on the flood magnitude were drainage area, mean annual precipitation, slope, and altitude. These were used as independent variables to derive equations for determining flood magnitudes for recurrence of 1.2, 2.33, 5, 10, 25, and 50 yr. From these equations, flood magnitude-frequency relations can be constructed. The procedure for computing flood magnitude is not applicable at sites where the drainage area is less than 10 sq mi or where the usable storage exceeds 4.5 million cu ft (103 acre-ft) per sq mi. (Knapp-USGS)
W70-00052

THE MECHANICS OF SURFACE RUNOFF,
Florida Univ., Gainesville. Dept. of Bioenvironmental Engineering.
John C. Schaake, Jr.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 105-116, 1967. 12 p, 5 fig, 1 tab, 12 ref.

Descriptors: *Runoff forecasting, *Mathematical models, *Digital computers, *Synthetic hydrology, Rainfall-runoff relationships, Routing, Unit hydrographs, Hydrograph analysis, Overland flow, Channel flow.
Identifiers: Drainage basin model.

The new digital computers with micro-second cycle times and core storage in excess of 30,000 words have made it practical to synthesize the surface runoff process by mathematical models. This synthesis involves simulating overland flow and flow in open channels and routing these flows through the watershed. The basic equations for the flow of flood waters in open channels and the basic equations for the overland flow of surface runoff have long been known to be the same, and they have been used by many investigators to route flood waves in rivers and to examine properties of overland flow hydrographs. Analytic solutions of these basic partial differential equations exist only for a few special cases of practical interest. In general, numerical solutions by finite difference methods are necessary. It is feasible and practical to synthesize the surface runoff process for small impervious watersheds. Runoff measurements are not needed so the procedure applies to ungaged areas. Friction coefficients must be estimated, but the computed hydrograph is not very sensitive to uncertainty in these coefficients. The mathematical model should be useful for studying the effects of the aerial variability of rainfall, for obtaining synthetic unit hydrographs for studying watershed linearity, and to provide data to test instrumentation designs for small watersheds. (Knapp-USGS)
W70-00055

SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Geography.
For primary bibliographic entry see Field 04C.
W70-00057

HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
South Dakota State Univ., Brookings.
William F. Lytle, and Shu-Tung Chu.
South Dakota Water Resources Institute, Research Project Technical Completion Report, September 1, 1969. 166 p, 5 ref, 7 append. OWRR Proj No A-012-SDAK.

Descriptors: Hydrograph, Hydrologic models, Runoff, *Surface runoff, *Unit hydrograph, *Watershed studies.

A study was made of nine South Dakota watersheds varying in size from two square miles up to 750 square miles to determine the usefulness of the parameter, 'The Time Base of the Instantaneous Unit Hydrograph.' This parameter was calculated from 100 storm runoff periods with no reference to the rainfall or 'rainfall excess' that was associated with the storm. A correlation analysis was run with the 'Time Base' and the physical measurements of the watershed. (Author)
W70-00137

EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-00142

DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
Hydronautics, Inc., Laurel, Md.
For primary bibliographic entry see Field 08B.
W70-00210

NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Cheng-lung Chen, and Chun-Tsung Wang.
ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6790, p 1671-1686, Sept 1969. 16 p, 10 fig, 11 ref, append.

Descriptors: *Open channel flow, *Unsteady flow, *Flow profiles, *Hydraulic jump, Supercritical flow, Turbulent flow, Hydraulics, Chezy equation, Mannings equation, Regime.
Identifiers: Gradually varied flow.

Chezy's and Manning's flow formulas are used to formulate flow equations for gradually-varied flow in wide rectangular channels. The flow equations are normalized by critical depth and critical slope, so that a parameter governing the flow is evident. This parameter is called normal-flow Froude number for flow on sustaining (mild, critical, and steep) slopes, and conceptual normal-flow Froude number for flow on adverse slopes. No third parameter governs flow on the horizontal slope. Critical depth, critical slope, and the normal-flow Froude number can be systematically found from nomographs for flow of a given discharge per unit width in a wide channel of given channel slope and roughness. Hydraulic-jump equations can also be normalized with the same normalizing quantities used in flow equations. Solutions of normalized flow and hydraulic-jump equations are graphically expressed, permitting direct use. (Knapp-USGS)
W70-00216

FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-00218

INVESTIGATION OF BRAHMAPUTRA RIVER,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
Abdul Latif.

ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6793, p 1687-1698, Sept 1969. 12 p, 7 fig, 4 tab, 4 ref.

Descriptors: *Flood control, *International waters, Rivers, Stream erosion, Dikes, Levees, Runoff, Streamflow, Surveys, River basin development, Water resources development, Water management (Applied).
Identifiers: *Brahmaputra River (India-Pakistan).

The Brahmaputra River, one of the largest rivers of the world, is international in character, originating in Tibet and flowing through India before reaching East Pakistan, and control of flooding from this river ia a major problem. The problem has been considered by several experts who have expressed the opinion that flood protection must be provided by river embankment. The Brahmaputra right bank embankment and the proposed left bank embankment are described. For the study of river regime and for developing design criteria for the flood control projects, detailed hydrographical and hydrological surveys of the river have been in progress since 1964. (Knapp-USGS)
W70-00219

ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
Tippetts-Abbett-McCarthy-Stratton, New York.
Armando Balloffet.
ASCE Proc, J Hydraul Div, Vol 95, No HY4, Pap 6695, p 1429-1451, July 1969. 23 p, 14 fig, 2 tab, 6 ref, append.

Descriptors: *Flood forecasting, *Synthetic hydrology, *Mathematical models, Hydraulics, Floods, Hydrograph analysis, Tides, Unsteady flow, Deltas.
Identifiers: Orinoco River (Venezuela), Sinu River (Colombia).

The one-dimensional equations of gradually varied, unsteady flow in open channels are integrated to obtain stages and discharges along a river subject to tides and floods. An explicit procedure of finite differences is used, considering branches, independent tributaries (pumps), contractions due to bridges or barriers, with or without tidal gates, and flood plains restricted or not by levees. The boundary conditions may be represented by: tides at both ends; tides at one end and discharge at the other; surge or stage hydrographs at any station; and combinations of the previous conditions. Three examples are presented covering a wide range of conditions. (Knapp-USGS)
W70-00226

FLOW RETARDANCE IN VEGETATED CHANNELS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-00228

TIDAL MODEL OF NORTHUMBERLAND STRAIT,
Acres (H. G.) and Co. Ltd., Niagara Falls (Ontario).
For primary bibliographic entry see Field 02L.
W70-00231

SPREAD OF BUOYANT JETS AT THE FREE SURFACE,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil ENGINEERING.
For primary bibliographic entry see Field 08B.
W70-00232

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
W. C. Boughton, and A. McKerchar.
J Hydrol, New Zeal, Vol 7, No 2, p 112-123, 1968. 12 p, 3 fig, 2 tab, 14 ref, 1 append.

Descriptors: *Simulation analysis, *Synthetic hydrology, *Streamflow forecasting, *Rainfall-runoff relationships, Mathematical models, Hydrologic data, Statistical methods, Computer programs, Probability, Sampling, Hydrograph analysis, Regression analysis.
Identifiers: *New Zealand, Thomas-Fiering models.

The Thomas-Fiering model for generation of synthetic streamflow records has been used with data from some New Zealand catchments. Available records are sparse and only 4 gaging stations have records of more than 20 years. Possible errors which can occur when short records are used to estimate monthly means, serial correlations, etc., are demonstrated. A simple simulation model for testing the difference between historic and synthetic records in determining reservoir size is described. A digital computer program listing for the simulation model is included. (Knapp-USGS)
W70-00251

OBSERVED LARGE-SCALE STRUCTURE OF TURBULENCE IN A RIVER MOUTH,
For primary bibliographic entry see Field 02L.
W70-00253

GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
Auckland Univ. (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W70-00254

GENERATION OF MONTHLY STREAM-FLOW DATA,
Ministry of Works, Wellington (New Zealand). Civil Div.
F. H. Pearson.
J Hydrol, New Zeal, Vol 7, No 2, p 101-111, 1968. 11 p, 2 fig, 11 ref, 1 append.

Descriptors: *Synthetic hydrology, *Hydrograph analysis, *Streamflow forecasting, *Rainfall-runoff relationships, Mathematical models, Hydrologic data, Statistical methods, Computer programs, Simulation analysis, Probability, Sampling.
Identifiers: *New Zealand.

Usually the length of a streamflow record is insufficient to contain extreme values and critical sequences required for the design of water-resource system components. Data are sometimes required for an ungaged stream. The Thomas-Fiering model may be used for the generation of a synthetic record of mean monthly streamflow of any required length. Data may be obtained by analysis of a shorter observed record for the stream, by analysis of regional characteristics of streamflow, or by analysis of the rainfall excess and consideration of storage in the catchment. Different considerations apply to the generation of synthetic flows for low-flow studies than for other types of problems. The extent to which the characteristics of an observed flow record will be reproduced in a synthetic record generated from the observed record is discussed. (Knapp-USGS)
W70-00255

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-00257

HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 08B.
W70-00319

FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
Agricultural Research Service, Bushland, Tex.
Jimmy R. Williams.
Trans Amer Soc Agr Eng, Vol 12, No 1, p 100-103, Jan-Feb 1969. 4 p, 7 fig, 3 tab, 7 ref.

Descriptors: *Flood routing, Hydrology, Storage coefficient, Outflows, Hydrographs, Inflow, Floods, Computer programming, *Flood hydrographs, Methodology.
Identifiers: Variables, *Travel time, Variation coefficients, *Flood hydrology, Brushy Creek (Tex).

The variable travel-time method and the variable storage-coefficient method for flood routing are described. These methods maintain the runoff volume without gain or loss during the routing computation. Although based on previous work, the methods include refinements that improve the accuracy of predicting flood-wave movement. The basis for the methods is the universal law of storage; that is, for a given time interval, the change in storage in a given reach is equal to the volume of inflow minus the volume of outflow. Because the methods preserve the correct volume, they will fill a need long felt. Both procedures are logical and adaptable to most flood routing problems. Good results were obtained when the methods were used on the Brushy Creek watershed in Texas. (USBR)
W70-00344

A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
Raikes and Partners, Rome (Italy).
T. R. E. Chidley.
J Inst Water Eng, Vol 23, No 3, p 177-186, May 1969. 12 p, 8 fig, 8 tab, 3 ref.

Descriptors: *Rivers, *River forecasting, River regulation, Hydrology, *Recession curves, Hydrographs, Hydrologic data, Discharge (Water), Runoff, Surface runoff, Methodology, *Streamflow forecasting, Rainfall.
Identifiers: Usk River, Great Britain.

A method of analyzing and forecasting river recession curves soon (3 days) after cessation of rain is presented. The principle underlying the method is to isolate the recession rate rather than the actual recession and then to relate this to parameters known to affect the recession rate. In this case, river discharge (implicitly a measure of groundwater levels), antecedent conditions, and season were used; other more objective parameters could be used. The basis for the method is numerical, and any recession curve can be analyzed automatically from a set of rainfall and runoff data by either computer or manual methods. All subjectivity has been removed from the analysis except in the choice of parameters believed to affect the recession rate. The method can be used as a subroutine for simulation of runoff data from rainfall records when a river is receding. (USBR)
W70-00353

FLOOD PREVENTION.
For primary bibliographic entry see Field 04A.
W70-00405

2F. Groundwater

RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
Kenneth L. Walters, and P. A. Glancy.
Wash Dep Water Resources Water Supply Bull No 26, 1969. 169 p, 8 fig, 4 plate, 5 tab, 19 ref, append.

Descriptors: *Water resources, *Groundwater, *Washington, Water wells, Aquifers, Hydrographs, Water levels, Water level fluctuations, Water yield, Water utilization, Irrigation water, Municipal

water, Water quality, Hydrogeology, Hydrologic data, Data collections.
Identifiers: Whitman County (Wash).

Whitman County covers about 2,200 sq. mi in southeastern Washington, adjacent to the Washington-Idaho boundary. Average annual precipitation in the county ranges from about 14 to 20 inches. Agriculture is the principal industry--chiefly dryland wheat farming, although some pasture and hay crops are irrigated. Much of the county is underlain by a thick sequence of basalt flows mantled by loess. Locally, older nonbasaltic crystalline rocks are exposed, principally in the eastern part of the county. The yield of large-diameter wells that penetrate several hundred feet of basalt in Whitman County is about 125 to 200 gpm for every 100 ft of saturated basalt penetrated. Adequate yields of water for domestic and stock supplies are commonly obtained from loess or from the contact between the loess and the underlying basalt. Pleistocene gravel deposits and Recent alluvium characteristically yield little water. Locally, however, yields of several hundred gpm are obtained from wells that penetrate the gravel, or the alluvium in the Snake River valley. Hydrographs of wells in the Pullman area indicate a continuing decline in water level. (Knapp-USGS)
W70-00012

FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 02G.
W70-00036

INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
Geologic Service of Belgium.
M. Gulinck.
Bull Int Ass Sci Hydrol, Vol 14, No 1, p 129-144, Mar 1969. 16 p, 13 fig.

Descriptors: *Aquifers, *Limestones, *Water level fluctuations, Hydrologic data, Pumping, Water wells, Water storage, Industrial plants, Water supply, Mathematical studies, Transmissivity, Theis equation, Seasonal, Permeability, Porosity, Karst, Compressibility, Mapping, Discharge (Water).
Identifiers: *Belgium, *Mouscron.

Pumping data recorded during the months of July and August 1956 at a pumping water well of 170 m in depth and drawing water from a Carboniferous limestone of the Mouscron, Belgium area, were analytically investigated on the basis of the simplified Theis-Jacob formula and certain mathematical assumptions. The confined aquifer of the limestone zone of the Roubais-Fourcoing-Mouscron area can be well analyzed by using the classic formulas of underground hydrology. The coefficients of transmissivity and water storage equal to 0.000275 sq m and 0.000103, respectively, computed analytically can be assumed to be acceptable as the mean hydrologic characteristics of the limestone aquifer. Some additional characteristics of the limestone aquifer can be deduced. (Gabriel-USGS)
W70-00040

RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02C.
W70-00201

THE GROUNDWATER SITUATION IN OHIO,
Geological Survey, Columbus, Ohio. Water Resources Div.
Stanley E. Norris.
Ground Water, Vol 7, No 5, p 25-33, Sept-Oct 1969. 9 p, 6 fig, 5 ref.

Descriptors: *Groundwater, *Water resources, *Ohio, Surveys, Hydrologic budget, Water sources, Aquifers, Glacial drift, Limestones, Snadstones, Water storage, Water pollution, Injection wells.
Identifiers: Groundwater resources (Ohio).

Present groundwater use in Ohio, approximately 650 mgd, amounts to about 5% of the water that enters the groundwater reservoirs. The largest groundwater supplies are developed where natural concentrations of water occur, chiefly in the watercourse aquifers, which consist of sand and gravel of glacial origin (outwash) in the valleys of the major streams. Other important aquifers are glacial outwash in upland areas and in the buried Teays Valley system, the limestone and dolomite aquifers in western Ohio, and sandstone and shale aquifers in the eastern half of the State. Future outlook is that more of the increasing water demand will be met from groundwater sources. Groundwater supplies will be developed at many new sites, and aquifers in areas already heavily pumped will be made to yield more water by the drilling of additional wells and recharging the aquifers artificially. Large quantities of groundwater in storage, virtually unexploited, could be used for temporary low-flow augmentation of streams. Management of groundwater resources will be needed to help solve supply and distribution problems, and to resolve conflicts between users. Among future problems will be those arising from underground disposal of wastes, a practice which is expected to grow substantially from enforcement of water-quality standards for streams, set under the Federal Water Quality Act of 1965. (Knapp-USGS)
W70-00203

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
Geological Survey, Denver, Colo.
E. A. Moulder, and C. T. Jenkins.
Ground Water, Vol 7, No 5, p 19-24, Sept-Oct 1969. 6 p, 8 fig, 3 ref.

Descriptors: *Computer models, *Analog models, *Digital computers, *Surface-groundwater relationships, Conjunctive use, Model studies, Simulation analysis, Optimization, Water management (Applied), Streams, Aquifers, Water demand, Water rights.
Identifiers: Hybrid computer models.

The best features of analog and digital computers were combined to make a management model of a stream-aquifer system. The analog model provides a means for synthesizing, verifying, and summarizing aquifer properties; the digital model permits rapid calculation of the effects of water-management practices. Given specific management alternatives, a digital program can be written that will optimize operation plans of stream-aquifer systems. The techniques are demonstrated by application to a study of the Arkansas River valley in southeastern Colorado. (Knapp-USGS)
W70-00204

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
Harza Engineering Co., Chicago, Ill. Water Resources Planning Div.; and Metropolitan Sanitary District of Greater Chicago.
For primary bibliographic entry see Field 05G.
W70-00205

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
Northern Illinois Univ., DeKalb. Dept. of Geology.
For primary bibliographic entry see Field 04B.
W70-00207

AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
Geological Survey, Helena, Mont.; and Pennsylvania State Univ., University Park. School of Forest Resources.
Ronald R. Shields, and William E. Sopper.
Study supported by OWRR-Dept of Interior, and McIntire-Stennis Coop Forestry Res Program. Water Resources Bull, Vol 5, No 3, p 37-49, Sept 1969. 13 p, 6 fig, 2 tab, 16 ref. OWRR Project A-006-PENN.

Descriptors: *Hydrogeology, *Surveys, *Geophysics, *Seismic studies, *Electrical studies, Aquifers, Water table, Water management (Applied), Subsurface mapping, Small watersheds, Water storage, Springs, Streams.
Identifiers: Groundwater prospecting (Geophysical).

The applicability of geophysical methods to experimental watershed research is demonstrated by a study of a 106-acre forested watershed in central Pennsylvania. Data from a shallow seismic refraction study and an electrical resistivity study of the watershed were used to determine the depth of soils, their volumes, depth to bedrock, configuration of the bedrock surface and delineation of the bedrock surface and of the water table. With this information on the subsurface conditions, the hydrologic properties of the watershed were described in greater detail. This information is of value in explaining the watershed's response to various watershed treatment practices that eventually will be used. (Knapp-USGS)
W70-00209

SALTWATER INTRUSION IN THE UNITED STATES.

Rep prepared by Task Committee on Saltwater Intrusion of Comm on Groundwater Hydrol of the Hydraul Div, ASCE. ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6788, p 1651-1669, Sept 1969. 19 p, 1 tab, 7 ref.

Descriptors: *Saline water intrusion, *Groundwater movement, *Groundwater, Aquifers, Coasts, Pumping, Recharge, Sea water, Seepage, Water levels, Water pollution sources, Water pollution control.
Identifiers: Saline groundwater.

The occurrence of saline groundwater in the U. S. is described in terms of geologic and hydrologic conditions. Three general mechanisms of intrusion are considered. The extent of salt water intrusion is given using a detailed listing of examples from throughout the United States. Statements are included regarding some of the areas where major control efforts are underway. (Knapp-USGS)
W70-00211

NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
Hydrogeological Station, Irkutsk (USSR).
V. A. Maliy.
Sovetskaya Geologiya, SSSR, Issue No 4, p 144-151, Apr 1969. 8 p, 5 fig, 1 tab, 11 ref.

Descriptors: *Subsurface runoff, *Water resources, *Groundwater basins, *Groundwater movement, *Base flow, Discharge (Water), Drainage water, Ice, Seasonal, Evaporation, Streamflow, Hydrogeology, Bogs, Hydrographs, River basins, Water loss, Watersheds (Basins), Wetting, Precipitation (Atmospheric).
Identifiers: *USSR, Irkutsk region.

Underground runoff of the Irkutsk amphitheater was investigated on the basis of geological and hydrogeological data recorded at 49 gaging stations located at several rivers and streams of the area. The whole area can be subdivided into 3 basin

groups characterized by their coefficients of underground runoff (underground runoff-precipitation ratio), by their coefficients of underground feeding of rivers, and general drainage, precipitation and wetting. Within the limits of each group the underground runoff reveals close association with precipitation, general runoff and general wetting. The association of the coefficients of underground runoff with the parameters is not clear-cut; however, it is still well identified. (Gabriel-USGS)
W70-00233

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
Sredneaziatskii Nauchno-Issledovatelskii Institut Irrigatsii, Tashkent (USSR).
For primary bibliographic entry see Field 03A.
W70-00243

COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
Japan Petroleum Development Corp., Tokyo.
Kinji Magara.
Amer Ass Petrol Geol Bull, Vol 52, No 12, p 2466-2501, Dec 1968. 36 p, 27 fig, 8 tab, 64 ref.

Descriptors: *Groundwater movement, *Compaction, *Consolidation, *Diagenesis, Permeability, Pressure, Earth pressure, Stress, Porosity, Sediments, Sedimentary rocks, Mud, Aquifers, Water sources.
Identifiers: *Japan, Oil migration, Reservoir dynamics.

The main hydrocarbon reservoirs in Nagaoka Plain, Japan, are volcanic and pyroclastic rocks. The migration of hydrocarbons seems to have occurred from adjacent sedimentary source beds to the volcanic reservoirs, facilitated by differential compaction. Therefore, it is possible to determine the directions of the compaction currents by using horizontal porosity distributions of covered mudstone bodies. The differential compaction maps of the mudst one source beds overlying the reservoirs may indicate the directions of hydrocarbon migration, and may suggest the location of hydrocarbon accumulations in Nagaoka Plain. The volumes of the compaction currents are estimated from the vertical porosity distributions and the porosity differences before and after compaction. The resultant figures in connection with the possible hydrocarbon accumulations. There are some abnormal pressures in the reservoirs of the Fujikawa, Kumo. The recent sedimentside, and Mitsuke gas and oil fields in the plain, whereas normal hydrostatic pressures are observed in the reservoirs of such fields as Katagai, Nishi-Nagaoka, and Higashi-Sanjo. This suggests the presence of permeability barriers in the volcanic reservoir rocks. The depths of the volcanic reservoirs and the thicknesses of the sealing mudstone beds are greater at Fujikawa, Kumoide, and Mitsuke, where abnormal pressures are found, than at Katagai, Nishi-Nagaoka, and Higashi-Sanjo, where reservoir pressures are hydrostatic. Therefore abnormal pressures in this district may be ascribed to the thick mudstone selas and overburden pressures. (Knapp-USGS)
W70-00246

ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
Research Council of Alberta, Edmonton.
Brian Hitchon.
Amer Ass Petrol Geol Bull, Vol 52, No 12, p 2318-2323, Dec 1968. 6 p, 4 fig, 5 tab, 9 ref.

Descriptors: *Porosity, *Sedimentary rocks, *Groundwater basins, Sandstones, Carbonate rocks, Limestones, Shales, Rock properties, Sedimentary petrology.
Identifiers: Canada, Alberta, Saskatchewan, Western Canada Sedimentary Basin.

Volumes of sandstone, shale, carbonate rocks, and evaporite, and pore volumes within each of these lithologic types, have been computed for 28 stratigraphic units in the plains region of the western Canada sedimentary basin. This region covers 486,785 sq mi and contains a total sedimentary fill of 537, 895 cu mi, with an average depth of 5,834 ft. Tertiary strata comprise 1.3%, Mesozoic strata 45.5%, and Paleozoic strata 53.2% of the total basin sedimentary fill. The average lithologic percentages for the total basin are: sandstone, 11.0; shale, 56.9; carbonate, 26.4; and evaporite, 5.7. The average basin porosity is 11.8%, with more than half the pore volume present in Mesozoic shale beds which comprise only 38% of the total basin fill. The average basin porosity for sandstone, shale, and carbonate is 15.7, 13.9, and 8.2%, respectively. The data are tabulated, with minimum comment, for reference purposes. (Knapp-USGS)
W70-00248

STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
Technische Hochschule, Karlsruhe (West Germany).
Claude Louis.
Elec De France, Bull Dir Etud et Rech, Ser A, No 3, p 5-132, 1968. 128 p, 78 fig, 52 ref.

Descriptors: *Groundwater, *Groundwater movement, *Joints (Geology), *Rock mechanics, Discharge (Water), Fissures (Geology), Laminar flow, Turbulent flow, Mathematical studies, Hydraulic properties, Viscosity, Pressure, Tunnel construction, Dam foundations, Soil properties.
Identifiers: Analytical study of groundwater flow.

The phenomenon of flow in jointed media and the stresses transmitted by seeping water to fissured rock are discussed. Systems of plane parallel joints are also investigated because of their existence in the majority of rock massifs. Flows are governed mainly by the geometry of the joint systems if the permeability of rock material, compared to that of the joints, is negligibly small. The factors affecting the geometry of the joint systems are analyzed and flow equations for seepage through open or filled joints are developed by using the principles of theoretical hydraulics and model tests, taking into consideration the form and surface roughness of the joints. Based on this analytical study, graphical and analytical methods for the determination of the potential distribution in joint media are developed. The stresses transmitted by seeping waters consist of shear forces, seepage pressures, and bouyancy. (Gabriel-USGS)
W70-00249

INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
South Dakota School of Mines and Technology, Rapid City.
For primary bibliographic entry see Field 02G.
W70-00310

A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
Hydrogeological Enterprise, Warsaw (Poland).
For primary bibliographic entry see Field 07B.
W70-00331

2G. Water in Soils

FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
Idaho Univ., Moscow.
Roy E. Williams, and David W. Allman.
J Hydrol, Vol 8, No 3, p 265-281, Jul 1969. 17 p, 13 fig, 16 ref. OWRR Proj No A-021-IDA.

Descriptors: *Infiltration, *Recharge, *Loess, Surface-groundwat er relationships, Soil water movement, Groundwater movement, Permeability, Anisotropy, Vegetation effects, Soil moisture, Tracers, Washington, Groundwater basins.
Identifiers: Loess recharge.

Hydrographs of shallow piezometers installed in a basin overlain primarily by loess reveal that water infiltrating and percolating through the loess recharges groundwater. Local gravity groundwater flow systems adjacent to some intermittent streams thereby are established. Relief on the water table is at a maximum during late winter or spring but decreases steadily through the summer when dry weather and maximal evapotranspiration minimize recharge. Several factors make the loess more or less susceptible to infiltration and percolation. Among the more important are cultivation practices and type of crop grown. Smooth, heavily worked surfaces (commonly planted in winter wheat) appear to act as a major limitation to infiltration capacity. Soil moisture concomitantly is low beneath such surfaces. Root mats developed beneath grassy surfaces provide optimal conditions for infiltration, and consequently for recharge. Measured infiltration capacities are often influenced by near vertical tabular openings extending to a depth of at least 30 ft in the loess. Tracer studies indicate that when sufficient water is available and when surficial infiltration capacity is sufficiently high to form a zone of positive pressure above these openings, they conduct water ahead of the saturation front. Water moves both downward in the openings and laterally into small rootlet holes in the matrix of the loess. By maximization of surface infiltration capacity it may be possible to utilize the tabular openings to induce groundwater recharge. (Knapp-USGS)
W70-00036

REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
Technion - Israel Inst. of Tech., Haifa; and Ministry of Agriculture, Tel Aviv.
For primary bibliographic entry see Field 02K.
W70-00045

PEAT AND MUCK DRAINAGE PROBLEMS,
Agricultural Research Service, Athens, Ga. Southeast Watershed Research Center.
For primary bibliographic entry see Field 04A.
W70-00229

NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
Hydrogeological Station, Irkutsk (USSR).
For primary bibliographic entry see Field 02F.
W70-00233

DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
Tashkent Univ. (USSR).
For primary bibliographic entry see Field 03A.
W70-00237

BIOLOGY AND ECOLOGY OF NITROGEN.
California Univ., Davis.
For primary bibliographic entry see Field 02K.
W70-00277

NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
For primary bibliographic entry see Field 02K.
W70-00288

MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
North Carolina Water Resources Research Inst., Raleigh.
Tarit Kumar Sarkar.

University of North Carolina, Ph D Thesis, 1969. 106 p. OWRR Proj A-012-NC.

Descriptors: *Rainfall-runoff relationships, Slopes, Subsurface drainage, Time lag, *Unsaturated flow.

An effort to explain the physics of unsaturated moisture flow problems through an inclined soil mass, a 914 cm long, 76 cm wide, and 12 cm deep, designed and constructed so that it could be tilted at any slope between 0 to 10 percent. The flume was filled to a depth of four feet with mortar sand. A rainfall simulator was designed to create desired rainfall intensities on the top of the flume. Three slopes, zero percent, 1.3 percent and 6.2 percent, were studied with rainfall intensities of .0016 cm/sec for a period of 120 minutes, and .0011 cm/sec for a period of 120 minutes respectively. A computer model was developed to supplement the physical model. In general the observed and calculated moisture contents and pressure distributions agreed within plus or minus 20.0 percent. The agreement between the observed and calculated outflow volumes was very poor with a maximum difference of about-75.0 percent at about 3200 minutes after the start of the rainfall. However, when the outflow volumes were calculated from the observed moisture content distribution, the agreement with the calculated volume was within about -30.0 percent. It is the opinion of the writer that the digital computer is a valuable tool for solving soil moisture flow problems but that the computer model developed in this study needs modification to take care of the fluctuating water table problems. An improvement on the measurement and distribution of the inflow volumes is also required.
W70-00307

INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
South Dakota School of Mines and Technology, Rapid City.
John Paul Gries.
So Dakota Water Resources Research Institute Project completion report, Sept 1969. 16 p, 1 fig, 10 ref, 2 append. OWRR Proj A-010-SDAK.

Descriptors: *Sinkholes, Caverns, *Water-loss, *Pahasapa Formation, Limestone, Black Hills, *South Dakota, *Springs.

Streams flowing radially from the Black Hills lose some or all of their water while crossing the outcrop of the Pahasapa (Madison) Limestone. Much is lost to sinkholes in the limestone, but some is temporarily lost to alluvium in the valley bottom. Careful geological examination of the stream channel at various stages of streamflow has located most of the points of water loss and return. Monthly discharge measurements have been made above, below, and between known points of loss on eight of the principal streams for a period of three years. The resultant profiles indicate free exchange between surface flow, flow through the alluvium, and flow through limestone cavern systems. Discharge measurements on resurgent springs indicates that most of the water lost to sinkholes returns to the surface. Temperature studies, and introduction of Rhodamine and fluorescein dye demonstrate that appreciable volumes of water regularly flow through the limestone by routes which are much more direct than the meandering path of the surface streams. They also suggest interdivide migration of water from one drainage basin to another. Observations during periods of high water and continuous flow across the zone of loss show that as the groundwater table rises, the ability of the subterranean passages to transmit water away from the intake area is reduced. Water losses to the sinkholes are consequently reduced until the water table returns to normal.
W70-00310

2H. Lakes

SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
Akademiya Nauk URSR. Marine Hydrophysics Inst.
B. A. Skopintsev.
Oceanology, Vol 8, No 3, p 328-341, 1968. 14 p, 6 tab, 35 ref. Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 3.

Descriptors: *Saline water, *Saline lakes, *Water chemistry, *Reduction (Chemical), *Sea water, *Oxidation, Biological properties, Bicarbonates, Sulfates, Phosphorus, Phosphates, Nitrogen, Organic matter, Anaerobic conditions, Solubility, Chlorine, Sulfides, Hydrogen sulfide, Magnesium.
Identifiers: *Black Sea.

Reduction and oxidation processes taking place in the Black Sea were investigated on the basis of detailed chemical studies and earlier publications. The quantity of bicarbonate carbon found in deep water does not correspond to the overall amount of reduced sulphur (as sulfite). On the basis of the average ratio of nitrogen to phosphorus in mixed plankton, 1+ can be postulated that the amount of phosphate phosphorus formed in deep water is less than the amount of ammonia nitrogen, and that there is a decrease in mineral nitrogen content near the surface. Probable causes for the phenomena are the existence of anaerobic processes for the decomposition of organic matter, lesser phosphate solubility in deep water, and the occurrence of an intermediate denitrification zone. (Gabriel-USGS)
W70-00048

ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
For primary bibliographic entry see Field 02J.
W70-00049

THERMAL STRATIFICATION IN LAKES: ANALYTICAL AND LABORATORY,
University of Science and Technology, Kumasi (Ghana); and Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.
Jonas M. K. Dake, and Donald R. F. Harleman.
Water Resources Research, Vol 5, No 2, p 484-495, Apr 1969. 8 fig, 1 tab, 20 ref.

Descriptors: *Thermal stratification, *Solar radiation, Lakes, Convective mixing, Heat transfer, Energy budget, Model studies, California.
Identifiers: Turbulent diffusion, Internal radiation, Thermal diffusion, Lake Tahoe, Vertical density, Variations.

Theories are developed for the time dependent vertical temperature distribution in a deep lake during the yearly cycle of solar heating and cooling. A heat flux balance at the water surface, which accounts for back radiation and evaporative heat loss, is formulated as a boundary condition. The linear, second-order heat transfer equation is solved by superposition of solutions for the surface absorbed radiation and the internally absorbed radiation. Analytical solutions are given for three different assumptions regarding the time dependence of the incoming radiation and the surface heat losses. At certain times, the resulting temperature and density distribution in the epilimnion are unstable. Under these conditions convective mixing and turbulent diffusion are accounted for by generating a surface mixed layer of uniform temperature, the depth determined by a thermal energy balance. The theory shows good agreement with field observations of temperature distributions in Lake Tahoe. Experiments are performed using artificial insolation (mercury vapor and infrared lamps) on a laboratory tank. We conclude that it is possible to simulate the development of thermal stratification under laboratory conditions. (Ross-Vanderbilt)
W70-00141

CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
Donald R. F. Harleman, Robert M. Bunker, and James B. Hall.
Univ of Michigan, Great Lakes Research Division, Pub No 11, p 340-356, 1964. 11 fig, 3 ref.

Descriptors: *Currents (Water), *Coriolis force, *Thermal stratification, Winds, Great Lakes, Lake Michigan, Thermocline, Air circulation, Water circulation.

Model studies were made to determine the effects of coriolis force, thermal stratification and surface currents on circulation and thermocline in Lake Michigan during the summer season. Detailed investigations in both static and rotating models were made for two cases: (1) north and south wind components operating together and (2) south wind operating alone; and with: (1) isothermal lake, (2) 40-ft thermocline, and (3) 25-ft thermocline. Conclusions were, for surface currents: (1) Rotation of the lake model produces major changes in the pattern of surface currents, (2) The existence and depth of a thermocline has a definite effect on both the direction and the velocity of surface currents produced by a constant wind source. For temperature stratification, it was noted that (1) Upon the incidence of thermal heating at the lake model surface a thermocline was almost immediately formed, (2) A consistent temperature gradient occurs near the epilimnion zone, and (3) The shape of the clinolimnion zone indicates that temperature distribution may well follow diffusion theory. General conclusions were (1) Modeling of gravitational and coriolis forces is apparently feasible and (2) More data on actual conditions existing in Lake Michigan are required before accurate modeling can be obtained. (Guerrero-Vanderbilt)
W70-00153

DEATH OF A LAKE,
For primary bibliographic entry see Field 05C.
W70-00264

CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
State Zoological Inst. and Museum, Hamburg (West Germany). Hydrobiological Station.
For primary bibliographic entry see Field 05C.
W70-00268

THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
Bristol Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 05C.
W70-00271

CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
For primary bibliographic entry see Field 05C.
W70-00274

INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
For primary bibliographic entry see Field 05C.
W70-00293

THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
North Dakota Univ., Grand Forks.
For primary bibliographic entry see Field 05C.
W70-00311

HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02C.
W70-00317

2I. Water in Plants

BIOLOGY AND ECOLOGY OF NITROGEN.
California Univ., Davis.
For primary bibliographic entry see Field 02K.
W70-00277

THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
Oak Ridge National Laboratory, Tenn. Radiation Ecology Section; and Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 02K.
W70-00284

AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
Concepcion Univ. (Chile). Departamento de Microbiologia.
For primary bibliographic entry see Field 02K.
W70-00286

INOCULATION OF LEGUMES IN BRAZIL,
Rio Grande do Sul, Porto Alegre (Brazil). Faculdade de Agronomia e Veterinaria.
For primary bibliographic entry see Field 02K.
W70-00287

PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
For primary bibliographic entry see Field 02K.
W70-00290

2J. Erosion and Sedimentation

COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
Geological Survey of Canada, Calgary (Alberta).
For primary bibliographic entry see Field 02C.
W70-00007

A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
Sydney Univ. (Australia). Dept. of Geography.
Edward J. Hickin.
Amer J Sci, Vol 267, No 8, p 999-1010, Oct 1969. 12 p, 4 fig, 4 plate, 8 ref.

Descriptors: *Sedimentation, *Alluvial channels, *Meanders, *Sedimentary structures, Model studies, Hydraulic models, Bank erosion, Stratigraphy, Stream erosion, Channel morphology, Flood plains, Turbulent flow, Supercritical flow.
Identifiers: *Point bars, Point dunes.

Sedimentation on stream bends developed at supercritical flow in a sand bed flume is examined in terms of a five-stage model. The model outlines the process by which deposits on the convex sides of meanders (point dunes) are formed. This mode of deposition, distinctly different from overbank and lateral accretion, also occurred at existing bends of the flume channel when the flow was subcritical and non meandering. Point dunes, which are examples of a feature in dynamic equilibrium, may also occur naturally when streams flowing over coarse noncohesive material are forced to change direction at valley bends. Field evidence, including a pilot mechanical analysis of sediment from a natural point dune, is presented which strongly supports the possibility. The significance and implications of the possible accordance of point dune and flood plain surfaces are discussed briefly. (Knapp-USGS)
W70-00034

A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
Netherlands Rijkswaterstaat, Arnhem. Engineering Dept. of Coastal Research.
W. T. Bakker.
Shore and Beach, Vol 36, No 2, p 5-14, Oct 1968. 10 p, 12 fig, 1 tab, 6 ref.

Descriptors: *Beach erosion, *Forecasting, *Mathematical models, Sediment transport, Sand waves, Ocean waves, Shore protection, Waves (Water), Currents (Water).
Identifiers: Netherlands, Vlieland.

A mathematical method is presented for predicting coastal erosion or aggradation using a series of yearly measurements of high and low water lines. The method was developed using data from the Dutch Wadden Isle of Vlieland, and proved useful in projecting erosion of the Isle's Coast. (Knapp-USGS)
W70-00043

URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
Yu. A. Kuznetsov, Z. N. Simonyak, A. P. Lisitsyn, and M. S. Frenklikh.
Geochem Int, Vol 5, No 2, p 306-313, 1968. 8 p, 3 tab, 28 ref. Transl from Geokhimiya, USSR, No 3, p 323-333, 1968. Published by Geochemical Society.

Descriptors: *Uranium radioisotopes, *Radium radioisotopes, *Surface waters, *Sediments, *Indian Ocean, Sea water, Sampling, Deposition (Sediments), Chemical analysis, Petrology, Seashores, Carbon, Iron, Silica, Calcium carbonate, Titanium, Phosphorus, Organic matter.
Identifiers: Oceanic sediments.

A study has been made of the spatial distribution of uranium and radium in the surface layer of Indian Ocean sediments. Several samples from the central and southern parts of the Ocean were examined. Eighteen of the 50 samples contain radium deposited directly from the water by sorption on the particles and uranium coprecipitates with dead organisms, phosphates, and hydroxides of Fe and Mn. The uranium content of the samples shows that there is no obvious correlation with the type of sediments, depth, or sampling position (distance from shore). (Gabriel-USGS)
W70-00044

SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.; and Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.
J. R. Schubel.
Shore and Beach, Vol 36, No 1, p 22-26, Apr 1968. 5 p, 6 fig, 2 ref.

Descriptors: *Erosion, *Sedimentation, *Estuaries, Sediment yield, Provenance, Sediment transport, Deposition (Sediments), Waves (Water), Currents (Water), Sands, Silts, Clays.
Identifiers: *Chesapeake Bay.

The mass of material eroded yearly from the shores of Chesapeake Bay is estimated by combining measurements of areal loss with relief data from topographic maps and field measurements. Cores show that very little eroded sand and gravel escapes the nearshore zone. Silts and clays, which make up 25-53% of the total eroded material, are transported much farther. Total annual shore sediment removal is about 0.3 million tons, of which about 0.1 million tons are silt and clay. River runoff contributes about 5 times this amount yearly, or about 0.20 inches of bay sedimentation per year of a total sedimentation of about 0.24-0.27 inches per year. (Knapp-USGS)
W70-00047

ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
D. D. Baranova, and G. G. Polikarpov.
Oceanology, Vol 8, No 3, p 341-344, 1968. 4 p, 5 tab, 6 ref. Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 3.

Descriptors: *Sediments, *Shallow water, *Adsorption, *Radioisotopes, Cesium, Silts, Carbonates, Chlorides, Gaging stations, Sampling, Water chemistry, Mussels.
Identifiers: *Black Sea sediments.

Shallow water sediments of the Black Sea were analyzed for the presence of rare elements. Among the sediments studied, the shallow-water silts exhibit a large absorptivity for Sr-90, Zr-95, Ru-106, Cs-137, and Ce-144. Phaseoline silt and aleuritic silt with mussel biocoenosis most effectively absorb Y-91, Zn-95, Cs-137, and Ce-144, but their affinity coefficients for Sr-90 and Ru-106 are low. The high rate or removal of Y-91 and Ce-144 from these silts by 0.2N HCl correlates with the presence of mineral carbonate in the silt. (Gabriel-USGS)
W70-00049

THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
Akademiya Nauk SSSR. Institut Okeanologii.
M. G. Yurkevich.
Oceanology, Vol 8, No 3, p 352-359, 1968. 8 p, 3 fig, 3 tab, 16 ref.

Descriptors: *Waves (Water), *Littoral drift, *Sands, *Sediment transport, Coasts, Winds, Hydrologic data, Meteorological data, Wind velocity, Energy transfer, Dynamics, Frequency, Statistical methods, Geology.
Identifiers: *USSR, Baltic coast.

Sand transporting properties of waves were analyzed on the basis of hydrometeorological observations recorded at three Baltic coast stations during the 1953-1964 period, and using an energy method. There are large variations in the sand-transporting characteristics when examined over a period of years. In the windiest years all the sand-transport parameters are 3-5 times those of the least windy years. The annual mean values of the sand-transporting parameters indicate that the energy-producing resultant force always lies to the right of the normal and forms an angle with it. (Gabriel-USGS)
W70-00050

THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
Karaganda Polytechnical Inst. (USSR); and Akademiya Nauk SSSR. Institut Okeanologii.
Yu P. Khrustalev, and F. A. Shcherbakov.
Oceanology, Vol 8, No 3, p 360-366, 1968. 7 p, 3 fig, 1 tab, 22 ref. Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 3.

Descriptors: *Sedimentation, *Sediment discharge, River flow, Bottom sediments, Erosion, River basins, Coasts, Abrasion, Dissolved solids, Estuaries, Geology, Silts, Sands, Shoreline cover, Carbonates, Mussels, Suspended load.
Identifiers: *Sea of Azov, *USSR.

Possible sources of sedimentary material in the Sea of Azov were investigated by taking into consideration the discharges of the Don and Kuban Rivers, shore erosion, and bottom erosion of the Sea of Azov. The rivers supply 19 million tons of material into the sea, and the shore erosion and bottom erosion products are estimated to be 17 million tons and 11 million tons, respectively. On the whole, river-derived material plays a significantly smaller role in the sediment balance of the Sea of Azov, than it does in the case of intracontinental water bodies. (Gabriel-USGS)
W70-00051

AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 04D.
W70-00060

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
Miami Univ., Oxford, Ohio.
For primary bibliographic entry see Field 02L.
W70-00067

MASS WASTING IN COASTAL ALASKA,
Forest Service (USDA) Pacific Northwest Forest and Range Experiment Station, Juneau, Alaska.
Douglas N. Swanston.
USDA Forest Serv Res Pap PNW-83, 1969. 15 p, 10 fig, 10 ref.

Descriptors: *Mass wasting, *Landslides, *Slope stability, *Debris avalanches, *Glacial soils, *Colluvium, Sediment yield, Soil erosion, Engineering geology, Soil engineering, Alaska.
Identifiers: Clear cuttings, Logged areas, Debris flows, Debris torrents, Southeast Alaska.

Mass wasting, a dominant form of slope reduction in coastal Alaska, is common where slopes are oversteepened by glacial erosion, soils are recent and shallow, and there is abundant rainfall. Timber harvesting by clear cutting appears to accelerate debris avalanching and debris flows. The most practical current policy to avoid landslide acceleration by timber harvesting is avoidance of slide susceptible areas. Old debris avalanche and flow scars are visible on aerial photos, but a more accurate evaluation of slide susceptibility can be made from a slope gradient map, which can be used to delineate potential slide areas and plan cutting patterns likely to cause the least slope disturbance. (Helmers-Forest Service)
W70-00164

SEDIMENT MEASUREMENT TECHNIQUES: A. FLUVIAL SEDIMENT,
Geological Survey, Washington, D.C.
Paul C. Benedict.
Prepared for Task Comm on Prep of Sedimentation Manual, Comm on Sedimentation, Hydraul Div, Vito A. Vanoni, Chairman. ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6756, p 1477-1514, Sept 1969. 38 p, 29 fig, 2 tab, 49 ref.

Descriptors: *Sediment load, *Sampling, *Measurement, Instrumentation, Sedimentation, Stream erosion, Scour, Sediment transport, Bed load, Suspended load, Statistical methods, Sediment discharge, Sediment yield, Frequency analysis.
Identifiers: Fluvial sediment measurement.

A description is given of modern techniques and equipment used to plan and make sedimentation measurements on natural streams. First, typical examples are given of sedimentation characteristics such as distribution of sediment with distance above the bed and variation of concentration with time and position in the stream cross section, for the purpose of illustrating some of the problems of sediment measurement. Equipment available is then described for obtaining suspended load concentration, bed load discharge and bed sediment samples. Next, the planning is outlined for making measurements at a cross section to obtain the sediment discharge of a stream and the procedure is presented for making the necessary calculations based on measured data. Finally the method of obtaining long-time records of sediment discharge is considered. This includes the determination of the frequency of making measurements in order to achieve the desired accuracy. The report is intended for the use of engineers not familiar with sediment measurement techniques on streams. (Knapp-USGS)
W70-00214

SEDIMENT MEASUREMENT TECHNIQUES: F. LABORATORY PROCEDURES,
Geological Survey, Washington, D.C.
Harold P. Guy.
Prepared for Task Comm on Prep of Sedimentation Manual, Comm on Sedimentation, Hydraul Div, ASCE. ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6757, p 1515-1543, Sept 1969. 29 p, 7 fig, 5 tab, 21 ref.

Descriptors: *Sediments, *Laboratory tests, *Sampling, Measurement, Particle size, Particle shape, Turbidity, Bed load, Suspended load, Logging (Recording), Instrumentation, Chemical analysis, Sedimentology, Settling velocity.
Identifiers: Sedimentation tubes, Sediment measurement.

A description is given of the technique and apparatus used in laboratory measurements usually made in connection with field sedimentation investigations. The expected and needed accuracy and reliability of measurements is first discussed. The various methods for determining sediment concentration in samples and forms for logging sample and laboratory data are presented. A number of methods for determining particle size and particle size-distribution are then described. These include the visual accumulation tube method and the bottom withdrawal tube method developed in recent years by several U. S. Government agencies as well as classical methods such as sieving and the pipet method. The final section deals with the less common measurement such as determination of the content of organic matter in sediment samples and dissolved solids in the water of the samples. The report is intended for the use of engineers not familiar with laboratory sediment measurements. (Knapp-USGS)
W70-00215

INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-00217

THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02L.
W70-00234

COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
Japan Petroleum Development Corp., Tokyo.
For primary bibliographic entry see Field 02F.
W70-00246

CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
Tulsa Univ., Okla.
Parke A. Dickey.
Amer Ass Petrol Geol Bull, Vol 52, No 12, p 2396-2421, Dec 1968. 26 p, 10 fig, 11 tab, 76 ref.

Descriptors: *Sedimentation, *Reviews, *Bibliographies, *Sedimentation rates, *Sedimentary basins (Geological), Provenance, Sediment yield, Deposition (Sediments), Geology, Sediment transport, Sediment distribution, Sediment load.
Identifiers: *Soviet Central Asia, Nonmarine sedimentation.

In Soviet central Asia sediments are being deposited in a wide variety of nonmarine environments. This is an area containing large inland seas similar to those that must have been present in the U.S. several times in the geologic past. Many ancient rock units were formed in epicontinental seas under similar conditions. The Caspian Sea is a huge lake of brackish water on whose margins are deltas of rivers, some draining tectonically active and other tectonically stable areas. Sands, muds, carbonates, and evaporites are being deposited in the sea, and their areal patterns can be related both to bathymetry and oceanography. East of the Caspian is a desert, partially covered by recent windblown sand. Rivers from high mountains on the south flow onto the desert, depositing broad areas of fine-grained, fluvial sand and silt. The Aral Sea is a smaller inland lake with two important deltas and a variety of bottom sediments. The recent sediments have been studied by Russian geologists and oceanographers for more than 30 years. Their work is described in several monographs and many technical articles, and a review of their work is presented. (Knapp-USGS)
W70-00247

AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
Department of National Hydrology (France).
J. P. Lepetit, and M. Hariguillie.
Elec De France, Bull Dir Etud et Rech, Ser A, No 3, p 133-148, 1968. 16 p, 11 fig, 3 ref.

Descriptors: *Model studies, *Erosion, *Silting, Charts, Instrumentation, Application equipment, Topography, Bedrock, Transportation, Suspended load, Sedimentation.
Identifiers: Hydraulic scale model.

An automatic streambed charting method using hydraulic model data is described. This method is also suitable for recording changes taking place between two successive surveys of erosion and silting and for calculating the volume of material moved. A bed probe covering the whole model collects the data which are converted to numerical form and transferred to a suitable IBM tape. This tape is processed by a computer after which a microfilm curve plotter generates bed charts giving constant sedimentation and erosion lines. The computer programs and instructions for their use are included. (Gabriel-USGS)
W70-00250

ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
B. A. Shulyak.
Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 6. Oceanology, Vol 8, No 6, p 785-791, 1968. 7 p, 2 fig, 1 tab, 21 ref.

Descriptors: *Sand waves, *Ripple marks, *Sedimentary structures, Currents (Water), Winds, Turbulence, Channel morphology, Model studies, Hydraulic models, Turbulent flow, Vortices, Mathematical studies, Equations, Sands, Silts, Sediments, Sedimentation.
Identifiers: *Waves (Noncohesive media).

The turbulence hypothesis of the formation of periodic waves, including dunes, ripple marks, etc. on the surface of a noncohesive medium is subjected to critical examination. It is shown that observational determinations of the relationship between periodicity and properties of the particles as well as the generation of waves under reverse motion conditions are not compatible with the tur-

bulence hypothesis. A mechanism for the generation of periodicity in wave-induced ripples is advanced. This has been described in previous papers by the author and it has been recently confirmed for ripples in a channel. (Knapp-USGS)
W70-00252

GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
Auckland Univ. (New Zealand). Dept. of Geography.
C. F. Pain.
J Hydrol, New Zeal, Vol 7, No 2, p 62-74, 1968. 13 p, 4 fig, 1 tab, 24 ref.

Descriptors: *Erosion, *Floods, *Geomorphology, Debris avalanches, Landslides, Mass wasting, Soil erosion, Vegetation effects, Canyons, Cloudbursts, Flood damage, Sediment yield, Slopes, Storms, Topography.
Identifiers: *New Zealand.

The supply of sediment to the channel network and the movement of this material down channel during high-intensity, low-frequency rainstorms is discussed with special reference to the Orere River catchment, New Zealand. Differences in channel form and process in forested and grassed catchments are noted. Under forest, debris flows are important in first-order channels where they remove infill from the channel bed and destroy vegetation beside the channel. Under grass these effects are not so marked. Slope failure under forest contributes vegetation, including large trees, which form debris dams in low-order channels. This rarely occurs under grass. Aggradation behind these obstacles slows down sediment transport, so that under forest the movement of material down channel is intermittent, while under grass it appears to be a relatively steady process. Evidence is presented to show the importance of low-frequency, high-intensity rainstorms as geomorphic factors. These storms cause marked slope failure and a catastrophic increase in debris supply to the channel network. It is suggested that concepts of magnitude and frequency of geomorphic forces need to be modified for areas where slope failure contributes most of the debris to the channel network. (Knapp-USGS)
W70-00254

INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02L.
W70-00259

SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
Agriculturai Research Service, Tucson, Ariz.
Kenneth G. Renard.
Trans Amer Soc Agr Eng, Vol 12, No 1, p 80-85, Jan-Feb 1969. 6 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Ephemeral streams, Hydrology, Sampling, Sediments, Time, *Sedimentation, Arizona, Arid lands, Semiarid land, Suspended sediments, Storms, Runoff, Surface runoff, Watersheds (Basins), Hydrometeorological station, *Sediment production, Gaging stations, *Sediment concentration, Soil erosion, *Stream erosion.
Identifiers: *Sediment rating curves, *Sediment samplers, Multiple regression, *Sediment-water relationship, Walnut Gulch Watershed (Ariz).

A sediment-sampling program was conducted on an ephemeral stream of the Walnut Gulch experimental watershed in Arizona in 1963-1964. Sediment concentration in an ephemeral stream, where runoff is generated from only a portion of the contributing watershed, is related to several independent variables indicative of the flow and hydrologic conditions at the time of the sample. Although a large amount of unanswered variability remains, the multiple-linear-regression technique answers some problems of a sediment-rating curve for semiarid ephemeral streams. Sediment concentration is not predictable using a simple additive equation involving coefficients of the independent variables involved. A better relationship is a multiplicative equation involving products of the independent variables with different exponents. Lapse time from the beginning of flow at the sampling station and the instantaneous discharge at the time of sampling were the 2 most important variables for predicting sediment concentration. Other variables were important in reducing the unexplained variance, but were more inconsistent between the stations considered in the analysis and were important rather for the sand, silt, or clay fractions of the total concentration.
W70-00343

2K. Chemical Processes

URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
For primary bibliographic entry see Field 02J.
W70-00044

REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
Technion - Israel Inst. of Tech., Haifa; and Ministry of Agriculture, Tel Aviv.
R. S. Mokady, and E. Bresler.
Soil Sci Soc Amer Proc, Vol 32, No 4, p 463-467, July-Aug 1968. 5 p, 7 fig, 2 tab, 11 ref.

Descriptors: *Ion exchange, *Soils, *Unsaturated flow, *Aqueous solutions, Electrolytes, Anisotropy, Ion transport, Leaching.
Identifiers: Ion exchange capacity (Soils).

The effective or apparent cation exchange capacity (E.C.) in flow through sandy-soil columns is reduced as the moisture content reduces. From experimental data it can be inferred that unsaturated flow may render the soil anisotropic for ion diffusion. In any case the leaching pattern appears as if some of the sites for ion exchange are not readily accessible under unsaturated flow. (Knapp-USGS)
W70-00045

QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
Princeton Univ., N.J. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 08G.
W70-00046

SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
Akademiya Nauk URSR. Marine Hydrophysics Inst.
For primary bibliographic entry see Field 02H.
W70-00048

ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
For primary bibliographic entry see Field 02J.
W70-00049

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
Miami Univ., Oxford, Ohio.
For primary bibliographic entry see Field 02L.
W70-00067

SALTWATER INTRUSION IN THE UNITED STATES.
For primary bibliographic entry see Field 02F.
W70-00211

TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
Miami Univ., Fla. Inst. of Marine Sciences.
H. Gote Ostlund, Murice O. Rinkel, and Claes Rooth.
J Geophys Res, Vol 74, No 18, p 4535-4543, Aug 20, 1969. 9 p, 6 fig, 2 tab, 16 ref. NSF Grants GP-1446, GP-3353, GP-5096.

Descriptors: *Tritium, *Atlantic Ocean, *Currents (Water), Sampling, Analytical techniques, Sea water, Salinity, Water temperature, Air circulation, Water transfer, Underflow, Equipment, Instrumentation.
Identifiers: *Equatorial Atlantic current.

This article describes improved sampling and analytical techniques for detection of ultra-low specific activity of tritium in sea water. Tritium data, salinity, and temperature as recorded by the Equalant III expedition of 1964 are presented. Negligible tritium penetration was found below the areal thermocline. Tritium-salinity relations support the concept that molecular exchange constitutes a major portion of the air to sea tritium flux. A time scale of a few years seems reasonable for transfer of distant surface water to the salinity and current cores of the Equatorial Atlantic undercurrent. (Gabriel-USGS)
W70-00224

PYROLYSIS OF HUMIC AND FULVIC ACIDS,
Geological Survey, Denver, Colo.
R. L. Wershaw, and G. E. Bohner, Jr.
Geochim et Cosmochim Acta, Vol 33, p 757-762, 1969. 6 p, 3 fig, 1 tab, 23 ref.

Descriptors: *Soil chemistry, *Humic acids, *Fulvic acids, Gas chromatography, Analytical techniques, Aromatic compounds, Soil chemical properties.
Identifiers: *Pyrolysis, Mass spectrometry, Polysaccharides.

Pyrolysis of humic and fulvic acids isolated from a North Carolina soil yields a variety of aromatic, heterocyclic and straight chain organ compounds. The pyrolysis products identified by gas chromatography and mass spectrometry indicate that humic and fulvic acids have aromatic and polysaccharide structures in their molecules. (Knapp-USGS)
W70-00241

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
Sredneaziatskii Nauchno-Issledovatelskii Institut Irrigatsii, Tashkent (USSR).
For primary bibliographic entry see Field 03A.
W70-00243

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
K. M. Khaylov, and Z. Z. Finenko.
Oceanology, Vol 8, No 6, p 776-785, 1968. 10 p, 7 fig, 14 ref. Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 6.

Descriptors: *Water chemistry, *Organic matter, *Solutes, *Sediments, *Sea water, Detritus, Chemical reactions, Absorption, Microorganisms, Aquatic microorganisms, Biodegradation, Nutrients.
Identifiers: *Macromolecular organic matter.

The physicochemical (sorption) and biochemical (microorganism-conditioned) interaction of surface-active macromolecular substances, recently

detected in sea water, with natural detritus and with organic matter in suspension are examined. In experiments with microorganism-populated natural detritus, it was shown that enzymatic hydrolysis of sorbed macromolecules takes place at the detritus surface, accompanied by sorption of fresh macromolecules from solution. As a result, a steady flow of material may exist in the 'dissolved marine organic matter - detritus' system. Under experimental conditions, the rate of this flow is about 3% of dissolved sea water macromolecules per day. It is suggested that a definite portion of the dissolved organic matter of sea water is brought into the food chain by consumption of detritus by filtering organisms. (Knapp-USGS)
W70-00258

SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
Missouri Univ., Kansas City. Dept. of Chemistry.
For primary bibliographic entry see Field 05A.
W70-00260

MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
California Univ., Los Angeles, Dept of Geology; and California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
For primary bibliographic entry see Field 02L.
W70-00262

AMMONIA NITROGEN LOSSES FROM STREAMS,
San Diego State Coll., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05G.
W70-00267

BIOLOGY AND ECOLOGY OF NITROGEN.
California Univ., Davis.

Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program, National Research Council. National Academy of Sciences, Washington, DC, publisher, 1969. 165 p, 10 fig, 36 tab, 310 ref. Proceedings of Conference California Univ, Davis, 28 Nov-1 Dec 1967.

Descriptors: *Nitrogen, *Nitrogen cycle, *Nitrogen fixation, *Physiological ecology, Nutrients, Nutrient cycling, Plant physiology, Symbiosis, Legumes, Fertilizers, Ecosystems, Crops, Productivity, California, Soils, Tropical regions, Grasslands, Dunes.
Identifiers: Biogeochemistry, Nutrient sources, Food production, Nitrogen balance, Brazil, Chile, Rhizobium, Nitrogen sources (Industrial), Nitrogen sources (Biological).

This report embodies the deliberations of a conference called to establish priorities for research and to consider means to improve coordination of studies in connection with the effect of nitrogen (N) on organisms and their environments, particularly as these relate to global food production. Scope of the technical considerations is indicated by subjects of individual contributions, which have been abstracted separately: biogeochemistry of N; marine N-cycle; symbionts of N-fixing plants; inputs for maximum productivity; significance of N-balances for nitrification; N-storage in California ecosystems; N-economy in grasslands and dunes; effects on soil productivity of N from legumes and crop residues; N-fixation by Chilean rhizobia and their symbiosis with legumes; inoculation of Brazilean legumes; nonsymbiotic N-fixation in tropics; importance of nonsymbiotic organisms in N-economy of tropics; and physiology of Rhizobium-legume symbiosis. In addition to details of technical deliberations, report includes a summary, findings, and recommendations; appendices encompassing a prospectus for comparing biological N-fixation with industrial sources, and a list of participants is also included. (See also W70-00278 thru W70-00290). (Eichhorn-Wisconsin)
W70-00277

THE BIOGEOCHEMISTRY OF NITROGEN,
California Univ., Davis. Dept. of Soils and Plant Nutrition.
C. C. Delwiche.
Biology and Ecology of Nitrogen, p 10-15, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 1 fig. Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967.

Descriptors: *Nitrogen, *Nitrogen fixation, *Nitrogen cycle, *Photosynthesis, Ammonia, Nitrates, Nitrites.
Identifiers: *Biogeochemistry, *Food quality, Nitrogen (Industrial).

A general discussion of biology and ecology of nitrogen, or, more precisely, of the effect of nitrogen on organisms and environment. The report stresses the need for an exact appraisal of the relative potential significance of symbiotic, nonsymbiotic, and industrial nitrogen fixation as related to the industrial application of photosynthetic reactions and the quality of produced crops. (See W70-00277). (Wilde-Wisconsin)
W70-00278

THE NITROGEN CYCLE IN THE SEA,
Washington Univ., Seattle. Dept. of Oceanography.
R. C. Dugdale.
Biology and Ecology of Nitrogen, p 16-18, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program, National Academy of Sciences, Washington, DC, publisher. 9 ref. Proceedings of Coneerence, California Univ, Davis, 28 Nov-1 Dec 1967.

Descriptors: *Nitrogen cycle, *Oceans, *Tropical regions, *Nitrogen fixation, *Kinetics, Phytoplankton, Zooplankton, Turnovers, Cyanophyta, Ureas, Eutrophication.
Identifiers: *Euphotic zone, *Marine deserts, Michaelis-Menton formula, Isotope-dilution measurements, Glycine, Algal blooms.

The use of nitrogen-15 suggested that the bulk of combined nitrogen (N) in deep sea waters is present as nitrate. The active N-cycle is largely confined to the upper layer of several hundred meters. Maximum activity is in the euphotic zone where phytoplankton consumes nitrates and ammonia released by zooplankton and bacteria. Nitrate accounts for 30% of N in productive regions, but for only 1% in 'deserts' of tropical seas. Kinetics for algal uptake of ammonia give estimate for Michaelis-Menton constant, K - 1 microgram-atom N/liter. Turnover time for ammonia in productive surface waters is about 40 hours; that of nitrate, about 50 hours. Combined N is provided by fixation of blue-green algae, particularly by Trichodesmium spp, forming heavy blooms and delivering as much as 0.32 kilogram N/hectare/day. Low oceanic oxygen levels, attaining less than 0.3% saturation, induce substantial denitrification. Uptake of labeled urea and glycine can be demonstrated, and some algae can use a variety of organic N-sources. (See W70-00277). (Wilde-Wisconsin)
W70-00279

NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
South Dakota State Univ., Brookings. Dept. of Bacteriology.
R. M. Pengra.
Biology and Ecology of Nitrogen, p 19-24, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program, National Academy of Sciences, Washington, DC, publisher. 14 ref.

Descriptors: *Nitrogen fixation.
Identifiers: *Plants (Nonleguminous), *Symbionts, *Leaf nodules, Phychotria bacteriophila, Klebsiella rubiacearum, Cross-inoculation, Aerobacter, Streptomycete endophytes, Fungal endophytes, Myrica, Alnus, Casuarinales, Ceanothus, Elaegnus, Rhamnus.

The nonleguminous plants capable of utilizing molecular nitrogen (N) include species of Alnus, Myrica, Casuarinales, Ceanothus, Elaegnus, Rhamnus, Hippophae, and Shepherdia. N-fixation in Phychotria bacteriophilia is accomplished by leaf nodules harboring Aerobacter (Klebesiella rubiacearum). Claims have been made that certain pines in association with fungus or fungal endophyte utilize molecular nitrogen. The streptomycete endophyte in the parenchymal cells of roots of Alnus glutinosa is believed to comprise three evolutionary forms: hyphal, vesicular, and bacteroidal. No streptomycete endophyte has been thus far isolated. Cross inoculation has been shown between species of Alnus and the family of Elaegnaceae. In all cases N-fixation required the presence of molybdenum. (See W70-00277). (Wilde-Wisconsin)
W70-00280

INPUTS FOR MAXIMUM PRODUCTIVITY,
California Univ., Davis. Dept. of Agronomy.
R. S. Loomis.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 25-30, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program, National Academy of Sciences, Washington, DC, publisher. 2 fig, 5 ref.

Descriptors: *Nitrogen fixation, *Legumes, *Productivity, Crop response, Cereal crops, Biomass.
Identifiers: *Symbionts, *Nitrogen (Industrial), Photosynthates, Resistance (Nitrogen), Ratios (Nitrogen:Carbon).

Maximizing the production of photosynthate is not always synonymous with optimizing the output. Canopies capable of a rapid photosynthesis must be coupled with plant types whose biomass consists largely of useful products. A key feature of new cereals is their tolerance to an abundance of nitrogen (N). Symbiotic N-fixation is accomplished at the expenditure of photosynthate and involves a direct drain on productivity, particularly pronounced when low-value legumes are rotated with high-value crops. Industrial nitrogen and nonsymbiotic N-fixation do not tax the energy material within the produced crops. (See W70-00277). (Wilde-Wisconsin)
W70-00281

SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
Tennesse Valley Authority, Muscle Shoals, Ala.; and Iowa State Univ., Ames. Dept. of Agronomy.
R. D. Hauck, and J. M. Bremner.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 31-39, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 10 ref.

Descriptors: *Nitrification, *Nitrogen cycle, Volatility, Denitrification, Leaching, Fertilizers, Inhibitors, Coatings.
Identifiers: *Nonphytotoxic chemicals, *Nitrogen loss, *Nitrogen retention, Chemodenitrification, 2-chloro-6-pyridine, 'N-serve', Inhibitors (Nitrification), Fertilizers (Organic).

The volatilization, denitrification, and leaching losses of nitrogen (N) are reduced by the use of fertilizers of limited solubility or biological degradation, such as magnesium ammonium phosphate, crotonylidenediurea, isobutyridenediurea, and ureaforms. The same goal is achieved by coating fertilizers with waxes, paraffins, acrylic resins, vinyl acetate, latex, gums, etc. An increase in the recovery of fertilizer N is sought by employing nonphytotoxic nitrification inhibitors, including thiourea, cyanamide, mercapto compounds, pyridine, and triazine derivatives. Studies indicated that 2-chloro-6- (trichloromethyl)-pyridine reduces the leaching and volatilization losses of fertilizer nitrogen. (See W70-00277). (Wilde-Wisconsin)
W70-00282

NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
California Univ., Berkeley. School of Forestry.
Paul J. Zinke.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 40-53, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 1 fig, 4 tab, 7 ref.

Descriptors: *Biomass, *Nitrogen, *California, *Ecosystems, *Forests, Soils, Precipitation.
Identifiers: *Sierra Nevada (California), Chaparral microforest, Ponderosa pine, Douglas fir, Redwoods, Granite, Andesite, Site index, Forest litter.

Storage of nitrogen (N) was determined in chaparral, mixed coniferous, and redwood ecosystems. The relative level of N-enrichment of either soil or plant tissues was influenced by the nature of vegetative cover. Increase in precipitation augmented the N-content of forest ecosystems. The total amount of N ranged from 200 grams/square meter in the chaparral microforest to 2,750 grams/square meter in redwoods. Mixed conifers showed intermediate values. About 11 percent of N of ecosystem occurred in trees of redwood forests. (See W70-00277). (Wilde-Wisconsin)
W70-00283

THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
Oak Ridge National Laboratory, Tenn. Radiation Ecology Section; and Colorado State Univ., Fort Collins. Dept. of Agronomy.
Roger Dahlman, Jerry S. Olson, and Kenneth Doxtader.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 54-82, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 3 fig, 9 tab, 59 ref.

Descriptors: *Nitrogen cycle, *Grasslands, *Ecosystems, Prairie soils, Systems analysis, Model studies.
Identifiers: *Shoot-root turnover, Income-loss balances, Steppe soils, Missouri prairie, Dune soils, Meyer's quotient, Lang's quotient, Transeau's quotient.

A preliminary model of nitrogen (N) cycle for a native grassland ecosystem is presented. Available results suggest that an appreciable fraction of nitrogen is returned in available form by the shoot and root turnover. Mineralized nitrogen from these sources is nearly adequate to satisfy the minimum requirements of higher plants. Because evaluations of nitrogen inventory and microbial transformations are incomplete or inadequately estimated, authors conclude that further progress in systems analysis of N-cycle depends upon completion of field studies bearing on transformations. (See W70-00277). (Wilde-Wisconsin)
W70-00284

EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
California Univ., Davis. Dept. of Agronomy.
W. A. Williams.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 83-89, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 2 tab, 13 ref.

Descriptors: *Nitrogen, *Nitrogen cycle, *Legumes, *Decomposing organics, *Soil structure, Mineralization, Corn (Fields), Cotton, Crops, Fertilization.
Identifiers: *Crop residues, *Decomposition (Aerobic), *Decomposition (Anaerobic), *Soil fertility, Cowpeas, Nitrogen release, Nitrogen immobilization.

The nitrogen content needed for decomposition of straw under anaerobic conditions is about one-third of that required for decomposition of crop residues in aerobic environment (0.54% versus 1.5%). Rice crop residues in flooded soils are apt to release rather than to immobilize nitrogen during decomposition. High-nitrogen residues which decay very rapidly have a short-lived effect on soil structure and are of little benefit to the crop that follows incorporation. (See W70-00277). (Wilde-Wisconsin)
W70-00285

AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
Concepcion Univ. (Chile). Departamento de Microbiologia.
Raul Zemelman.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 90-100, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, Publisher. 5 tab, 18 ref.

Descriptors: *Nitrogen fixation, *Legumes, Symbiosis.
Identifiers: *Phosphorus fixation, *Microbial strains, Trifolium pratense, Trifolium subterraneum, Medicago sativa, Chile, Rhizobium meliloti, Rhizobium trifolii.

Greenhouse and field trials revealed no effective native Chilean strains of Rhizobium meliloti in symbiosis with Medicago sativa. More than 30% of the native strains of Rhizobium trifolii were effective with Trifolium pratense and 11.5% with T subterraneum. More than 300 U/phosphorus pentoxide/hectare (unit of application not defined otherwise in report) were needed for establishment of symbiosis in soils having a high capacity for phosphorus fixation. (See W70-00277). (Wilde-Wisconsin)
W70-00286

INOCULATION OF LEGUMES IN BRAZIL,
Rio Grande do Sul, Porto Alegre (Brazil). Faculdade de Agronomia e Veterinaria.
J. R. Jardim Freire, Carlos F. Goepfert, and Caio Vidor.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 101-113, 1969. Production Processes Subcommittee (E R Lemon, Chairman) US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 3 fig, 6 tab, 12 ref.

Descriptors: *Legumes, *Fertilizers, Trace elements, Sulfur, Nitrogen, Potassium, Phosphorus, Aluminum, Manganese.
Identifiers: *Brazil, *Rhizobium, *Microbial strains, State of Rio Grande do Sul (Brazil), Toxicity (Aluminum), Toxicity (Manganese).

Authors stress the importance of the selection of suitable strains of Rhizobium for nitrogen-fixation and adjustment of soil fertility by application of lime, nitrogen, phosphorus, sulfur, and trace elements. High content of potassium, as well as toxicity of aluminum and manganese, depress the effect of inoculation. (See W70-00277). (Wilde-Wisconsin)
W70-00287

NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
Johanna Dobereiner.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 114-128, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 8 tab, 25 ref.

Descriptors: *Nitrogen fixation, *Tropical regions, *Soils, Azotobacter, Acid soils, Temperature.
Identifiers: *Nitrogen fixation (Nonsymbiotic), *Beijerinckia, Derxia, Azotobacter paspali, Paspalum notatum, Sugar cane, Acid soils (Tropical), Thermal optima, Carbon sources.

Acid tropical soils harbor at least six nonsymbiotic bacteria which have a capacity of fixing from 12 to 30 milligrams of nitrogen (N) per gram of carbon source. The growth-promoting effect of Beijerinckia indica and Azotobacter paspali was particularly pronounced. The rate of N fixation depended on temperature, A paspali and Derzia spp requiring from 33 to 37 deg C. (See W70-00277). (Wilde-Wisconsin)
W70-00288

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
Instituto Agronomico, Campinas (Brazil).
Francisco da Costa Verdade.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of Nitrogen, p 129-152, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 4 tab, 128 ref.

Descriptors: *Nitrogen fixation, *Nitrogen cycle, *Tropical regions, *Soils, Leaching, Erosion, Fertilizers, Rain water.
Identifiers: *Nitrogen fixation (Nonsymbiotic), *Beijerinckia, *Soils (Tropical), Sao Paulo State (Brazil), Climate-nitrogen function, Lateritic (Feralitic) soils, Photochemical fixation of N, Rice, Sugar cane, Grasses, Brazil, Nitrogen (Sources), Nitrogen (Crop removal), Terra roxa soils.

In spite of a prolonged cultivation, certain types of terra roxa soils fail to respond to application of nitrogen (N) fertilizers. The author assumes that the consumption of N by crops is compensated by nonsymbiotic N-fixing organisms. A possibility of inoculation with bacteria of the genus Beijerinckia is suggested as a means of increasing the yield of rice, sugar cane, and grasses. (See W70-00277). (Wilde-Wisconsin)
W70-00289

PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
Martin Alexander.
Proceedings of Conference, California Univ, Davis, 28 Nov-1 Dec 1967. Biology and Ecology of

Nitrogen, p 153-156, 1969. Production Processes Subcommittee (E R Lemon, Chairman), US Nat Committee for International Biological Program. National Academy of Sciences, Washington, DC, publisher. 10 ref.

Descriptors: *Physiological ecology, *Legumes, Alfalfa.
Identifiers: *Rhizobium, *Antimetabolites, *Coconut water, *Symbiotic specificity, Alpha-picolinic acid, Alpha methylglutamic acid, Saccharomyces carlsbergensis, Inositol, Niacin, Gum-producing strains, Benzene-hexachloride, Seed extracts (Alfalfa), Growth regulators, Nodulation.

Nodulation of excised roots of alfalfa was enhanced by extracts of alfalfa seed. Coconut water exerted a similar effect on excised roots of several legumes. Purification of coconut water on activated charcoal yielded a fraction effective in the nodulation bioassay test. This fraction of 4000-fold purification appears to be effective at concentrations from 1 to 0.1 parts per million and may be considered as a growth hormone or growth regulator. The antimetabolite alphapicolinic acid prevented nodulation of birdsfoot trefoil, but had no effect on the growth of the plant. Benzene hexachloride and alpha-methylglutamic acid inhibited nodulation of excised bean roots, but not the root development. Pyridine-3-sulfonate increased nodulation of bean plants. These effects are reminiscent of the influence of Saccharomyces carlsbergensis. A streptomycin-resistant, phage-sensitive strain of Rhizobium trifolii was able to survive irradiation, but proved to be nonnodulating. (See W70-00277). (Wilde-Wisconsin)
W70-00290

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
Black and Veatch, Kansas City, Mo.
For primary bibliographic entry see Field 05F.
W70-00308

2L. Estuaries

A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 08B.
W70-00003

A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
Netherlands Rijkswaterstaat, Arnhem. Engineering Dept. of Coastal Research.
For primary bibliographic entry see Field 02J.
W70-00043

URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
For primary bibliographic entry see Field 02J.
W70-00044

SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.; and Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.
For primary bibliographic entry see Field 02J.
W70-00047

THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
Karaganda Polytechnical Inst. (USSR); and Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02J.
W70-00051

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
Miami Univ., Oxford, Ohio.
A. Dwight Baldwin, Jr.
Proc 3rd Annu Amer Water Resource Conf, Nov 8-10, 1967, San Francisco, Calif, p 548-562, 1967. 15 p, 10 fig, 8 ref.

Descriptors: *Water quality, *Hydrogeology, *California, Aqueous solutions, Water chemistry, Solutes, Provenance, Geology, Runoff, Groundwater movements.
Identifiers: California Coastal drainage basins.

Water samples from 4 coastal streams between Half Moon Bay and Davenport, California, were collected and analyzed to determine the factors governing the rate of solute erosion. Geologic controls upon the dissolved solids content result from the complex petrology and structural geology in this section of the outer Coast Ranges. Between 35 and 40% of the chloride removed yearly enters the basins as fine dust derived from the zone of breaking surf along the coast. In the San Lorenzo watershed, during the water year 1960-61, mean discharge was only 25.8 cfs. Solute load for this water year was 52.5 tons/sq mi/year. During the water year 1958-59, the solute load rose to 515 owing to an increase in mean discharge to 278 cfs. Results of this study indicate that conditions favorable for a rapid rate of solute erosion are those least favorable for a high rate of suspended solid removal. (Knapp-USGS)
W70-00067

DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
Drexel Inst. of Tech., Philadelphia, Pa.; and New York Univ., Bronx, N.Y. Dept. of Civil Engineering.
Michael D. Disko, and Erick R. Gidlund.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 563-577, 1967. 15 p, 8 fig, 6 ref.

Descriptors: *Dispersion, *Estuaries, *Fresh water, Currents (Water), Tides, Water level fluctuation, Path of Pollutants, Diffusion, Streamflow, Tidal effects, Mixing.
Identifiers: Estuarine dispersion.

An analysis of an ideal estuary section, using the principles of conservation of mass and momentum together with relationships between velocity and tidal amplitude, results in an equation which predicts the spatial and temporal behavior of the friction velocity. The friction velocity and, hence, the dispersion vary throughout the tidal cycles. Dispersion reaches a maximum value at high or low water slack and decreases as the mean water depth occurs in the estuary. The experimental verification essentially consisted of a series of measurements of the spread of instantaneous injections of fluorescein dye and saline water in order to determine concentration and dispersion patterns in a model estuary. Results from the experimental program show that the average level of dispersion, initially zero at dye injection, gradually rises over a period of two or more cycles until an equilibrium state is reached. Instantaneous dispersion values in the model, however, follow a cyclical pattern predicted by the above analysis of an ideal estuary section. Also, results show that the higher the tidal range or river inflow into the estuary, the larger the dispersion. (Knapp-USGS)
W70-00068

THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
Central Electricity Generating Board, Portishead (England). Research and Development Dept.
For primary bibliographic entry see Field 05C.
W70-00150

CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
J. W. Ramster, and H. W. Hill.
Nature, Vol 224, No 5214, p 59-61, Oct 1969. 3 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Ocean circulation, Ocean currents, Water circulation, Synoptic analysis, Tides, Tidal effects, Oceanography, Tracers, Tracking techniques, Current meters.
Identifiers: *Irish Sea.

Direct measurements were made of the tidal streams in the northern Irish Sea by tracking seabed drifters released near the Isle of Man. A drift toward the south in the center of the area was determined. Current meters were installed by 5 cruises since 1966 and current data obtained are tabulated and mapped. It is suggested that the main deep flow of the Irish Sea is associated with a deep channel in the northwestern part and does not pass east of the Isle of Man as do the surface currents. (Knapp-USGS)
W70-00202

SALTWATER INTRUSION IN THE UNITED STATES.
For primary bibliographic entry see Field 02F.
W70-00211

WINTER CIRCULATION IN THE GULF OF ALASKA,
Washington Univ., Seattle. Dept. of Oceanography.
Gunnar I. Roden.
J Geophys Res, Vol 74, No 18, p 4523-4534, Aug 20, 1969. 12 p, 8 fig, 23 ref. ONR Contract 477 (37).

Descriptors: *Water circulation, *Alaska, *Winter, *Estuaries, Seasonal, Thermal stratification, Water temperature, Saline water, Velocity, Mass transfer, Eddies, Atmospheric pressure, Winds, Mathematical studies, Density.
Identifiers: *Gulf of Alaska.

The steady-state winter circulation in the Gulf of Alaska was investigated and related to the main thermohaline features of the Gulf. Vertical stratification consists of three principal layers at depths of 100, 200, and over 200 meters respectively. The total mass transport between the surface and the bottom is about 10 million gr/cm/sec. Counterclockwise eddies are found in the semi-enclosed northern part of the Gulf characterized by its westward water transport. Between latitudes 50 deg and 55 deg N, total transports are predominantly westward and represent return flow from eastward transports further south. In general, the velocity structure with depth often shows a maximum in the halocline, providing a mechanism for the formation of warm and cold water cores which are frequently observed in the Gulf of Alaska. (Gabriel-USGS)
W70-00220

THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
Scripps Institution of Oceanography, La Jolla, Calif.
Paul D. Komar.
Work partly supported by Scripps Inst of Oceanography. J Geophys Res, Vol 74, No 18, p 4544-4558, Aug 20, 1969. 15 p, 9 fig, 2 tab, 21 ref. ONR Contract NONR-2216 (23).

Descriptors: *Turbidity currents, *Channel flow, *Estuaries, *California, Coriolis force, Pressure, Velocity, Density, Friction, Canyons, Mathematical studies, Slopes, Pleistocene epoch, Sedimentation rates, Erosion, Sediment discharge.
Identifiers: *Monterey Channel.

Turbidity currents of the Monterey deep-sea channel were investigated analytically and experimentally by using the Chezy equation and setting up an

equation that balances the centrifugal and Coriolis forces against the pressure force that results from the cross-channel surface slope. This balancing equation was utilized for calculation of average velocity curves versus density, the two variables in the equations, and the two principal unknowns of turbidity current flow. The equations were applied to the fathograms of 12 crossings taken along a 100 km stretch of the channel. The channel velocities vary from 600 to 2000 cm/sec under conditions of permissible densities, values comparable to the velocities obtained from ordered sequences of submarine cable breaks. Using velocities deduced from the level height differences, it is found that a reasonable range of Pleistocene slump volumes in the Monterey Canyon is capable of generating channel-full turbidity currents of adequate length and time of passage. Solution of equations under a wide range of sediment discharge rates indicates no substantial erosion of the channel since the Pleistocene. (Gabriel-USGS)
W70-00223

TIDAL MODEL OF NORTHUMBERLAND STRAIT,
Acres (H. G.) and Co. Ltd., Niagara Falls (Ontario).
James E. Cowley.
ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap 6551, p 827-838, May 1969. 12 p, 13 fig.

Descriptors: *Tidal effects, *Ocean currents, *Water circulation, *Coastal engineering, *Hydraulic models, Water levels, Bridges, Highways.
Identifiers: *Northumberland Strait (Canada), Prince Edward Island (Canada).

A model was made to study the effects of a proposed highway crossing on the tidal circulation of Northumberland Strait between the mainland and Prince Edward Island, Canada. The model represented an area of about 5,000 sq mi. The small model scale and the scale distortion of 100:1 were corrected with empirically derived adjustments. It was concluded that significant changes in tidal levels, tidal currents, and storm surge heights will be avoided if an opening equal to at least 1/3 of the present flow area of the Strait is incorporated in the crossing. Increases in the range of high- and low-tidal levels will be extensive if the Strait is completely closed by a causeway. Experience in operating the model has demonstrated that modern control and measuring systems can accurately reproduce and record tides in a model with a time scale as great as 800. The model was adequate at these scales for investigation of the gross changes in tide impedance which would result from the erection of partial barriers across the Strait. In common with some highly distorted river models, however, the best calibration of this model was achieved by a departure from the theoretical rules for similitude, indicating that a more moderate scale distortion would be required for studies of more subtle phenomena, such as details of long distance circulations or mixing and dispersion of salinity or pollutants. (Knapp-USGS)
W70-00231

THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
Akademiya Nauk SSSR. Institut Okeanologii.
V. P. Jenkovich.
Russian original with English summary. Okeanologiya, Moscow, USSR, Akad Nauk, Vol 9, Issue 2, p 256-270, Mar-Apr 1969. 15 p, 8 fig, 19 ref.

Descriptors: *Seashores, *Sediments, *Boreholes, Erosion, Sands, Algae, Calcium carbonate, Silts, Forests, Peat, Tides, Currents (Water), Coral, Runoff, Geomorphology, Mapping, Lagoons, Reef, Topography.
Identifiers: *Cuba, Coastal line of Western Cuba.

The coast of Western Cuba was investigated by using geological, hydrological and borehole data recorded by the Soviet-Cuban expedition of 1965. In many places boreholes revealed surfaces of wind erosion at depths up to 13 meters. The study shows that presence of a certain algae species and some chemically-formed calcium carbonate. Peat layers up to 1 m in thickness are present at the edge of the mangrove forest. Strong tidal currents are responsible for the existence of ridge-like relief in sands and silts of Western Cuba. (Gabriel-USGS)
W70-00234

SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
Meteorological Service of the City of Hanoi (North Vietnam).
Nguyen Ngoc Thuy.
Russian original with English summary. Okeanologiya, Moscow, USSR, Akad Nauk, Vol 9, Issue 2, p 235-249, Mar-Apr 1969. 15 p, 9 fig, 2 tab, 25 ref.

Descriptors: *Tidal waters, *Seashores, *Tides, *Estuaries, Electronic equipment, Hydrologic data, Frequency analysis, Energy equation, Mapping, Gaging stations, Hydrodynamics, Friction, Waves (Water), Velocity, Resonance.
Identifiers: *Tidal phenomena, *South China Sea.

A numerical computation of tidal characteristics of the South China Sea was made by using the Hansen method and an electronic computer (BESM-2M), and disregarding the drag effects. The results of the study were plotted on the maps showing the parameters of tides and tidal currents of the South China Sea. In spite of some shortcomings, the results of the study should be considered as more reliable as compared with the similar results of earlier investigations in the same area. The conditions under which the tidal phenomena of the South China Sea are formed and the reason for the existence of large diurnal tidal components are also discussed on the basis of the analysis of resonance phenomena energy, depth, and other pertinent parameters. (Gabriel-USGS)
W70-00235

ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
For primary bibliographic entry see Field 02J.
W70-00252

OBSERVED LARGE-SCALE STRUCTURE OF TURBULENCE IN A RIVER MOUTH,
B. S. Shteynman.
Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 6. Oceanology, Vol 8, No 6, p 768-770, 1968. 3 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Turbulence, *Streams, Vortices, Eddies, Sedimentation, Erosion, Channel morphology, Turbulent flow, Frequency analysis.
Identifiers: Macroturbulence.

Field measurements were made of large-scale turbulence in the mouth of the Kura River. Expressions are given for the autocorrelation function at various distances from the mouth and for the laws which govern the changes of large-scale turbulence along the river stream in the coastal waters. In particular, the sharp damping of helical circulation in the river mouth and the decrease of size of turbulent perturbations seawards are discussed. (Knapp-USGS)
W70-00253

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
For primary bibliographic entry see Field 02K.
W70-00258

INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
V. S. Medvedev, and N. M. Krivonosova.
Transl from Okeanologiya, Akad Nauk, SSSR, Vol 8, No 6. Oceanology, Vol 8, No 6, p 792-803, 1968. 12 p, 10 fig, 13 ref.

Descriptors: *Suspended load, *Bays, Tides, Currents (Water), Turbidity, Erosion, Waves (Water), Beach erosion, Provenance, Sampling, Silts, Clays.
Identifiers: *USSR, *White Sea.

Data on the quantitative content of suspension at 109 stations in Dvina, Onega and Mezen Bays and the northern part of the White Sea are presented. Maps of the distribution of suspensions at the surface and in the bottom layer are compared for rising and falling tide. The structure of flows of suspended sediments and the role of tides in the dynamics of suspended material are analyzed. It is concluded that the origin of suspended material is chiefly abrasive and that it is localized in a comparatively narrow coastal zone. (Knapp-USGS)
W70-00259

MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
California Univ., Los Angeles, Dept of Geology; and California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
B. J. Presley, R. R. Brooks, and I. R. Kaplan.
Science, Vol 158, No 3803, p 906-910, Nov 1967. 1 fig, 2 tab, 18 ref.

Descriptors: *Sediments, *Manganese, *Connate water, Pacific Ocean, California, Iron, Cobalt, Sodium, Diffusion, Oxidation, Reduction (Chemical), Geochemistry, Water chemistry, Oxidation-reduction potential.
Identifiers: *Chemical oceanography, Nickel, Lithium, Enrichment, Nodules (Magnanese), Nodule formation, Deep sea sediments.

Analyses for manganese, nickel, iron, cobalt, sodium, and lithium in the interstitial water of two cores from the California Borderland and six deep-sea cores from the East Pacific Rise showed considerable variation in the concentration of trace elements. Oxidizing near-shore sediments showed marked enrichment in manganese in contrast to sulfide-rich reducing sediments which showed no enrichment when compared to average seawater. Iron and nickel showed the reverse trend. In the deep-sea sediments, concentrations of trace metals were variable, with all except one core showing high enrichments (50-3000 fold) in dissolved manganese, with a maximum concentration of 6.6 parts per million. Nickel and cobalt concentrations followed the same trend, whereas, in near-shore sediments, nickel and iron showed similar patterns; two cores showed 50-fold enrichment in nickel and cobalt. Since concentrations of soluble divalent manganese violated predictions from thermodynamic data, author suggests that solution manganese was present in free as well as in complexed form. Analyses of solid phase of the deep-sea sediments showed manganese to be concentrated in the top layers (0-20 centimeters), apparently supporting the theory of manganese nodule formation in deep-sea sediments by diffusion of manganese from depth to the surface. (Browman-Wisconsin)
W70-00262

THE NITROGEN CYCLE IN THE SEA,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W70-00279

STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
Federal Water Pollution Control Administration, West Kingston, R.I.
For primary bibliographic entry see Field 05C.

W70-00417

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
Nebraska Univ., Lincoln.
Wm. A. Scheller, and Carl E. Georgi.
Nebraska Water Resources Research Institute, Technical Completion Report, September 1, 1969. 11 p, 7 tab, 12 ref, append: Biochemical Fuel Cell. OWRR PROJECT No. A-007-NEB.

Descriptors: *Electrodialysis, *Economics, Cost, Brackish, Fresh, Desalination, Nebraska, Water.

Samples obtained from four brackish wells in eastern Nebraska and two NaCl solutions were used in conjunction with a laboratory electrodialysis unit to establish the process parameters necessary for estimating the cost of desalination. Investment and maintenance estimates for a 1000 GPD electrodialysis unit were also obtained. The cost of fresh water (500 ppm total solids) produced from brackish water (980 to 6460 ppm of total solids) was $2.30 to $7.78 per 1000 gallons including a 5 percent cost for investment capital. At a typical rural consumption of 60 gallons per person per day, the above fresh water costs are equivalent to 14 cents to 48 cents per person per day. These figures assume electric power is available at 3.3 cents/kwh, a typical rural Nebraska rate. If the electrodialysis unit were supplied with brackish water from an existing pressurized system and with reduced maintenance costs, the desalinated water costs would be reduced by 57 cents to $1.59 per 1000 gallons, depending on the specific case.
W70-00139

DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
Tashkent Univ. (USSR).
G. V. Mironicheva.
Akhboroti Izvestiya, Uzbek SSR, Akad Nauk, Issue No 3, p 68-70, 1969. 3 p, 1 ref.

Descriptors: *Leaching, *Saline soils, *Saline water systems, *Drainage water, *Mathematical studies, Soils, Groundwater, Diffusion, Salinity, Porosity, Filtration, Velocity, Water chemistry, Forecasting, Soil chemistry.
Identifiers: Desalination with no drainage.

Desalination of soils with no drainage was investigated by setting and solving a diffusion equation, and using the solution techniques developed by N. N. Verigin, A. Begmatov, and D. F. Shul'gin. Final solutions, obtained by using the Lagrange method, permit the forecasting of salt supply changes in the soil after the end of desalination processes. The analysis of the derived formulas indicates that salt contents increase with depth, and the conclusion is supported by recorded data of soil salinity. (Gabriel-USGS)
W70-00237

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
Sredneaziatskii Nauchno-Issledovatelskii Institut Irrigatsii, Tashkent (USSR).
R. V. Savel'yeva, and V. A. Baron.
Akhboroti Izvestiya, Uzbek SSR, Akad Nauk, Issue No 3, p 39-43, 1969. 5 p, 1 fig, 7 ref.

Descriptors: *Leaching, *Groundwater movement, *Soil water movement, *Water quality, *Water chemistry, Mathematical studies, Aquifers, Permeability, Climates, Agricultural engineering, Diffusion, Filtration, Sorption, Streamflow, Porosity, Salinity, Estuaries, Rivers, Fourier analysis, Laplaces equation, Forecasting.
Identifiers: Desalination of salt-bearing formations.

Saline and water regimes of soils and grounds of arid regions were analytically investigated to determine the effects of molecular diffusion, sorption, filtration, thermal diffusion, and pressure. By using the equations given by V. V. Rachniskiy (1964), the Laplace transformations, and the Fourier series, the final equation was derived which by knowing the filtration velocity, determines the mineralization of groundwaters in the area under investigation. By knowing the profile of initial soil salinity, the magnitude of filtration stream, and other parameters (porosity, diffusion, water salinity, overburden thickness), the final formula can be utilized for the forecasting of ground salinity regimes. (Gabriel-USGS)
W70-00243

3B. Water Yield Improvement

MANIPULATION OF WATER USE IN AN ASPEN FOREST,
Utah State Univ., Logan. Coll. of Natural Resources.
John D. Schultz, George B. Coltharp, George E. Hart, Jr., and Michael Zan.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 149-159, 1967. 11 p, 3 fig, 1 tab, 13 ref. OWRR Proj A-004-UTAH.

Descriptors: *Water yield improvement, *Utah, *Evapotranspiration control, Forest management, Defoliants, Watershed management, Vegetation.
Identifiers: *Aspen trees.

Aspen forests were treated with sprayed antitranspirant and defoliant to study the possibility of improving watershed yield by evapotranspiration control. Both treatments caused increased runoff yield, and it is concluded that significant changes in the water use budget in Aspen forests can be accomplished. Preliminary data are tabulated and shown by graphs. (Knapp-USGS)
W70-00058

DESIGN OF CLOUD SEEDING PROGRAM,
North American Weather Consultants, Goleta, Calif.
Robert D. Elliott.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR2, Pap 6600, p 275-284, June 1969. 10 p, 6 fig, 3 tab, 2 ref.

Descriptors: *Cloud seeding, *Weather modification, *Network design, *Meteorological data, *Telemetry, Instrumentation, Statistical methods, Irrigation water, Rainfall, Snow management, Streamflow.
Identifiers: Convection band, Experimental design.

Evaluation of the results of cloud seeding in test projects in mountain areas during the winter season would be speeded by the use of a natural mesoscale unit of observation, the convection band. This creates a requirement for real-time telemetry of observations and remote controlled seeding. The use of the natural sub-unit of a winter storm, the convection band, is illustrated by meteorological examples taken from a design study for a Southern Sierra test program. An examination of historical precipitation data showed that with a reasonable assumption as to seeding effects, this method of testing might show statistically significant results in one year; whereas, the conventional seasonal streamflow comparison would require 26 yr, 13 of them seeded and 13 unseeded. Ultimate operational application of these new concepts is explained. (Knapp-USGS)
W70-00230

3C. Use of Water of Impaired Quality

SEA PLANTS FOR FOOD,
Southampton Univ. (England).
J. E. G. Raymont.
The New Scientist, p 10-11, July 18, 1957. 1 fig.

Descriptors: *Marine plants, *Algae, Chlorination, Sodium compounds, Photosynthesis, Carbon dioxide, Nitrates, Phosphates.
Identifiers: *Phaeodactylum, *Gas effluent, Food production, Southampton University.

A marine algae crop of Phaeodactylum has been experimentally grown but not subjected to thorough chemical analysis which would estimate its food value, or protein produced per nutrient intake. The dry weight of the harvested crop was 1/3 gram per liter culture which was a favorable beginning result. Heat sterilization was the preferred procedure in the filtering and sterilizing steps. A commercial ammonium sulfate was used as fertilizer. Algae growth depended on a strong enough light source and was therefore grown in shallow areas and in the winter by artificial lighting. Carbon dioxide for the photosynthesis was supplied as successfully by effluent waste gases of partially purified waste water as by cylinders. The effluent carbon dioxide is hoped to decrease the need for nitrate and phosphate. (Sherman-Vanderbilt)
W70-00161

3D. Conservation in Domestic and Municipal Use

SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).
For primary bibliographic entry see Field 06E.
W70-00103

JOINT OPERATION OF WATER SOURCES.

Ky Rev Stat Ann secs 74.420, 74.430 (1963).

Descriptors: *Kentucky, *Cities, *Water supply, *Operations, Legislation, Water sources, Water resources development, Construction, Water districts, Water users, Legal aspects, Local governments.
Identifiers: Ordinances, Acquisition.

Provisions are made herein for the definition of 'sources of water supply.' Any two or more cities or any two or more water districts organized under this chapter or any combination of such cities and water districts may jointly acquire, by purchase or by construction, sources of water supply and may jointly operate such supply and improve and extend the same. The governing body of any city or water district may adopt a resolution or ordinance determining and electing to acquire and jointly operate sources of supply of water. (Heckerling-Florida)
W70-00276

ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.

Ky Rev Stat Ann secs 85.140, 85.150 (1963).

Descriptors: *Kentucky, *Rivers, *Sewers, *Navigation, Legislation, Regulation, Drains, Culverts, River regulation, Docks, Cities, Local governments, Administrative agencies, Taxes, Legal aspects.
Identifiers: Ferries.

The common council, by ordinance, establishes and erects public buildings, public ways, sewers, culverts, and gutters, and promotes and regulates navigation on any navigable river within or adjoin-

ing the city. The council licenses, taxes, and regulates ferries across any river within the limits of the city. It also erects wharves, docks, and landings and regulates stationary anchorage and mooring of vessels and rafts. (Moulder-Florida)
W70-00304

JOINT CONSTRUCTION OF WATER SUPPLY.

Ill Ann Stat ch 24, secs 11-126-1, 11-126-3, 11-126-4 (Smith-Hurd 1962).

Descriptors: *Illinois, *Water works, *Water supply, *Reservoirs, Legislation, Legal aspects, Cities, Construction, Maintenance, Contracts, Condemnation, Streams, Water pollution, Jurisdiction, Regulation, Impounded waters, Water sources, Local governments, Pollution abatement, Water pollution control.

Cities may provide a water supply for fire protection and for use by inhabitants by: (1) construction and maintenance of a waterworks system; (2) joint construction of such a system with an adjacent city; (3) procurement of a supply of water from an adjacent city with an existing waterworks system. There is provision for the letting of contracts for the construction of waterworks systems. Cities may acquire property outside their corporate limits for the purpose of constructing, maintaining, or supplying a system of waterworks; similarly, city jurisdiction is extended ten miles beyond its corporate limits for the purpose of preventing pollution or injury to the source of water for the supply of the waterworks. The authorities of each city may make and enforce rules and regulations necessary in the construction and management of its waterworks system and for the use of water supplied thereby. City authorities may also make and enforce regulations necessary for the improvement, care, and protection from pollution of the city's water supply source. The city may charge its inhabitants for water supplied them from the waterworks system. (Keith-Florida)
W70-00371

SOIL AND WATER CONSERVATION DISTRICTS LAW.
Ill Ann Stat Ch 5, secs 106-138.2 (Smith-Hurd 1966).

Descriptors: *Illinois, *Water policy, *Water resources, *Water resource development, Natural resources, Conservation, Legislation, Regulation, Administration, Management, Administrative agencies, State governments, Water, Water conservation, Flood control, Floodwater, Project planning, Recreation.

The Illinois Soil and Water Conservation Districts Advisory Board is established and its organization, powers and duties are delineated. Regulations pertaining to the creation of soil and water conservation districts including petition, notice, and hearing provisions as well as necessary Department of Agriculture findings and determinations are set forth. The Department determines whether the operation of the proposed district is administratively practical. Provisions for a district governing body are set forth and powers of the various districts and their directors, including development and publication of conservation plans and erosion control measures, acquisition of property, cooperation with individuals and government agencies, and powers of suit, are enumerated. Adoption of land use regulations, district consolidation and division regulations, and regutory provisions for formation of subdistricts and district discontinuance provisions are set forth. (Moulder-Florida)
W70-00403

CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
California Tomorrow, San Francisco, Calif.
Samuel E. Wood.

In Planning 1968, Selected Papers from the ASPO National Planning Conference, San Francisco, p 270-277, May 4-9, 1968. 8 p.

Descriptors: *Conservation, *Natural resources, Economic impact, Technology, Natural resources, Government, Pricing, Population, Pollution, Rivers, Lakes, Pesticides, Government subsidies, Federal government, State government, Local government.
Identifiers: *Economic development, Capital improvement.

The article is concerned with the apparent dichotomy of conservation and economic development. Much of the blame for the current state of resource destruction is placed on the city and county governments. The author suggests that the relative state, local and federal responsibility for resource conservation needs a review. The author feels all federal grants and capital improvement programs should be conditioned on area-wide planning and administration. The federal government should also encourage the states into assuming more meaningful responsibilities for protecting the environment. In addition, the federal government should realign its various programs to effectuate development of sound urban units and electronic-data processing should be fully enlisted in resource conservation. Since water resources often enter conservation issues and problems, this article has relevance to water research dealing with institutional and governmental relations. (Murphy-Rutgers)
W70-00415

3E. Conservation in Industry

PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.

Ind Ann Stat sec 46-1620 (1965).

Descriptors: *Indiana, *Oil industry, *Beds under water, *Leases, Legislation, Permits, Land tenure, Oil fields, Land use, Shores, Structures, Natural resources, Beds, Relative rights, Legal aspects, Lake beds, River beds.
Identifiers: *Preferential rights.

When an application for a prospecting permit or lease to river beds, lake beds, and shore lands is made, the owner of the right to prospect for, develop, and produce petroleum from the abutting lands shall have a preferential right to a prospecting permit for a 30 day period after he has received notice of such application. If petroleum has already been discovered in any structure underlying such abutting lands, the owner of the right shall have a lease to the portion of such river bed, lake bed, and shore lands as adjoin such abutting lands upon the terms and conditions herein provided, notwithstanding any acreage limitations herein provided as to permits and leases. (Heckerling-Florida)
W70-00112

SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).

353 A2d 701-705 (Me 1969).

Descriptors: *Maine, *Atlantic salmon, *Fish conservation, *Condemnation, Judicial decisions, Salmonids, Salmon, Anadromous fish, Commercial fish, Conservation, Wildlife conservation, Legal aspects, Administrative agencies, Administration, Fish, Water conservation, Fish management, Fish migration, Flow control, Flow rates, Dams, Hydroelectric plants.

Defendant Commissioner of Inland Fisheries and Game had certain of plaintiff's property, including two hydroelectric dams, condemned for the public purpose of conserving Atlantic sea run salmon. Plaintiff sought a declaratory judgement to determine the validity of the condemnation order alledging among other things that, while the legislature had provided for the conservation of such fish, it had not specifically provided the Commissioner with the power to condemn property for that purpose. The Supreme Judicial Court of Maine, in declaring the taking void, held that because the legislature had not specifically determined that public exigencies require the taking of certain properties for the purpose of regulating the flow of river water for the protection of salmon, the Commissioner had no power to condemn plaintiff's property, and the taking had no effect as to plaintiff and his title in and to the property purportedly taken. (Johnson-Florida)
W70-00188

WATER RIGHTS.
For primary bibliographic entry see Field 04C.
W70-00198

FISH AND WILDLIFE RESOURCES.
Ky Rev Stat Ann secs 150.445-150.991 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Regulation, *Fishing, *Fishing gear, Legislation, Administration, Fish, Rough fish, Minnows, Crayfish, Baits, Electrical shocking gear, Explosives, Fish toxins, Commercial fishing, Sport fishing, Nets, Seines, Recreation, Mussels, Poisons.

Regulations pertaining to the use of commercial and sport fishing gear are set forth. Substances that are injurious to fish and aquatic life are not to be used in fishing. No person may use any electrical device or poison for taking fish. Limits on the number and size of fish taken are delineated. Live bait dealers must obtain a license from the Department of Fish and Wildlife Resources. Musseling operations may be carried on only after a license has been obtained from the Department. Possession of nets such as gill nets, trammel nets, illegal seines, and other nets not authorized by the commissioner is prohibited. Regulations pertaining to the taking of water fowl in the state are provided. Revenue bonds may be issued to establish public lakes, and the Department of Highways is authorized under certain conditions to construct lakes. 'Pay lakes' are defined and pertinent regulations are provided. (Moulder-Florida)
W70-00199

3F. Conservation in Agriculture

MANIPULATION OF WATER USE IN AN ASPEN FOREST,
Utah State Univ., Logan. Coll. of Natural Resources.
For primary bibliographic entry see Field 03B.
W70-00058

A NEW METHOD OF IRRIGATION,
R. L. McWhorter.
Ga B J, Vol 13, No 1, p 114-116, Aug 1950. 3 p.

Descriptors: *Georgia, *Sprinkler irrigation, *Diversion, *Reasonable use, Irrigation engineering, Legal aspects, Damages, Land tenure, Irrigation, Water utilization, Water conveyance, Water consumption, Water law.
Identifiers: Upper landowner, Lower landowner.

Irrigation, however it is accomplished, is a commercial use, and the riparian proprietor is limited to a reasonable appropriation. In order for a riparian owner in Georgia to irrigate his land and not subject himself to a lawsuit, he must only use a reasonable amount of water and must turn that which is not reasonably used back into the main channel before it passes the land of the proprietor below. With the sprinkler system of irrigation being used more and more it is quite conceivable that the courts will be called upon to rule whether irrigation

is legally the same as diversion. Those who contemplate irrigating their lands should get a written agreement from the person below which in effect grants to the upper proprietor the right to take water in such manner. (Heckerling-Florida)
W70-00090

BIOLOGY AND ECOLOGY OF NITROGEN.
California Univ., Davis.
For primary bibliographic entry see Field 02K.
W70-00277

INPUTS FOR MAXIMUM PRODUCTIVITY.
California Univ., Davis. Dept. of Agronomy.
For primary bibliographic entry see Field 02K.
W70-00281

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
Instituto Agronomico, Campinas (Brazil).
For primary bibliographic entry see Field 02K.
W70-00289

EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
Ohio Agricultural Research and Development Center, Wooster; and Agricultural Research Service, Columbus, Ohio.
J. R. Hoover, and G. O. Schwab.
Trans Amer Soc Agr Eng, Vol 12, No 1, p 150-152, Jan-Feb 1969. 3 p, 3 fig, 6 tab, 6 ref.

Descriptors: Drainage, *Drainage systems, *Tile drainage, Wheat, Oats, *Tile drains, Drain tiles, Rainfall, *Discharge (Water), Agronomy, Corn (Field), Crops, Agriculture, *Dishcarge measurement, Depth, Percolation, Permeability.
Identifiers: *Tile spacing.

A tile drainage experiment to determine relationships between tile flow and cropping practices, drain depth, and drain spacing was conducted in Ohio from 1951 to 1966. Moisture for crops was supplied by rainfall. Narrow (30-ft) drain spacings resulted in a higher tile discharge than the wider (60-ft) spacing. Long-season crops resulted in lower tile discharge than crops growing actively during a small portion of the growing season. Narrow drain spacings and a long-season previous crop result in a lower soil moisture content throughout the year, promoting proper soil moisture conditions for tillage, planting, and harvesting operations. Timeliness of tillage and harvesting are some benefits of good drainage and long-season crops. A measure of the degree of drainage obtained by a tile system is given by the probability of occurrence of tile flow rates. The probabilities of flow during March, April, and May are useful for designing tile systems because these are the months of highest tile discharge and also the months when the seedbed must be prepared for row crops. (USBR)
W70-00351

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
Corps of Engineers, Rock Island, Ill.

Corps Eng Flood Plain Rep, June 1969. 105 p, 37 fig, 15 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Mississippi River, *Illinois, *Iowa, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Rock Island County (Ill), Scott County (Iowa), Muscatine County (Iowa), Standard project flood, Intermediate regional flood.

Flooding of the Mississippi River, Rock Island County, Illinois, and Scott and Muscatine Counties, Iowa is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability of flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-00001

ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS.
Corps of Engineers, Rock Island, Ill.

Corps Eng Flood Plain Rep, June 1969. 67 p, 48 fig, 20 plate, 11 tab.

Descriptors: *Floods, *Flood damage, Illinois flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Mississippi River, Historic flood.
Identifiers: *Rock River (Ill), Standard project flood, Intermediate regional flood.

Flooding of the Rock River, Rock Island County, Illinois is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-00004

FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN.
Corps of Engineers, Chicago, Ill.

Corps Eng Flood Plain Rep, Aug 1969. 48 p, 31 fig, 18 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Wisconsin, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Wolf River (Wis), Standard project flood, Intermediate regional flood.

Flooding of the Wolf River, Wisconsin is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-00008

FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA.
Corps of Engineers, Pittsburgh, Pa.

Corps Eng Flood Plain Rep, June 1969. 51 p, 10 fig, 15 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Pennsylvania, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Meadville (Pa), Standard project flood, Intermediate regional flood.

Flooding of French and Cussewago Creeks, Meadville, Pennsylvania is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-00010

DRAINS AND LEVEES AFFECTING HIGHWAYS.
For primary bibliographic entry see Field 04C.
W70-00011

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
City Univ., London (England). Dept. of Civil Engineering.
C. Venetis.
J Hydrol, Vol 8, No 3, p 341-346, July 1969. 6 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Reservoir operation, *Streamflow forecasting, *Water storage, *Probability, Markov processes, Statistical methods, Mathematical models, Distribution.
Identifiers: Reservoir deficit forecasting.

The distribution of the relative frequency of deficit in N years of reservoir operation is examined, treating the reservoir content as a homogeneous, finite Markov chain. This distribution is conditional on the initial state of the system. It is derived from the m-step transition matrices via the waiting and the recurrence time distributions. The theory is applied to a simple numerical example. (Knapp-USGS)
W70-00041

FLOOD PLAIN INFORMATION, WESTFIELD AND LITTLE RIVERS, WESTFIELD, MASSACHUSETTS.
Corps of Engineers, Waltham, Mass.

Corps Eng Flood Plain Rep, June 1969. 64 p, 9 fig, 7 plate, 11 tab.

Descriptors: *Floods, *Flood damage, Massachusetts, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Westfield (Mass), Standard project flood, Intermediate regional flood.

Flooding of the Westfield and Little Rivers, Westfield, Massachusetts is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-00042

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES: PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02E.
W70-00052

A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 02A.
W70-00053

RIPARIAN RIGHTS - REASONABLE USE THEORY.

Ark L Rev, Vol 19, No 2, p 193-194, Summer 1965. 2 p, 5 ref.

Descriptors: *Arkansas, *Riparian rights, *Reasonable use, *Dams, Judicial decisions, Water levels, Rivers, Land tenure, Land use, Remedies, Damages, Riparian land, Bayous, Drainage, Legal aspects, Relative rights.

Plaintiff and defendant, adjoining landowners, operated hunting and fishing enterprises. Defendant constructed three dams which prevented the normal drainage of a bayou onto plaintiff's land. Water entered the bayou from a nearby river when the river reached seventeen feet. However, due to one of the dams, water did enter until the river reached nineteen feet. Plaintiff brought a bill in equity seeking removal of the dam and damages. The chancery court directed removal or lowering of the dam but denied damages. On appeal, defendant was allowed to lower two of the dams. Under these circumstances when one lawful use of water interferes with or detracts from another, an equitable adjustment must be made. The present case clearly commits Arkansas to the reasonable use theory in deciding conflicts of interest between riparian owners. However, because of a paucity of decisions, the court's development of the theory is not extensive. The court in the principal case stated that it would not necessarily adopt all the refinements given the reasonable use theory by decisions of other states and that its interpretations would be developed as occasions arise. (Heckerling-Florida)
W70-00083

NAVIGATIONAL SERVITUDE: AN OLD CONCEPT WITH A NEW LIMITATION,
Robert D. Stein.
Buffalo L Rev, Vol 11, No 2, p 417-423, Winter 1962. 7 p, 43 ref.

Descriptors: *Navigation, *Federal government, *Eminent domain, *Compensation, Judicial decisions, High water mark, Condemnation, Easements, Interstate rivers, Power operation and maintenance, Riparian land, Riparian rights, Value, Land tenure, Land use, Non-navigable waters, United States, Legal aspects.
Identifiers: *Navigational servitudes, *Commerce, *Non-riparian uses, Fast lands.

Under the commerce clause of the Constitution, the federal government has the power of navigational servitude which allows the government to control the navigability of an interstate waterway by regulating its flow. The power of navigational servitude is not a new concept and stems from the early case law giving the government the right to control interstate navigable waterways. There are, however, limitations on the power. It can only be exercised over lands below the high water mark of the stream. If the government takes fast lands or a non-navigable stream, it must use its power of eminent domain and pay the owner just compensation. Recent decisions limit the power under the servitude to the high water water mark. In United States v Virginia Electric and Power Company, 350 U.S. 956 (1956), the government attempted to extend the power of navigational servitude to acquire a flowage easement held by the power company over fast land adjoining a navigable river. The Supreme Court adopted a formula which values the non-riparian uses of the land and then adds a probability factor, the probability of the easement's exercise, to apportion the damages between the fee owners and the easement owner. This case will undoubtedly have a limiting effect on the power of navigational servitude since the court allowed the power company payment for the value of the non-riparian uses of the land, but did not allow the company to be recompensed for the riparian value of the easement. (Heckerling-Florida)
W70-00084

ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.

Minn L Rev, Vol 38, p 685-689, 1954. 5 p, 23 ref.

Descriptors: *Minnesota, *Recreation, *Public rights, *Condemnation, Bodies of water, Judicial decisions, Land tenure, Lakes, State governments, Public benefits, Legal aspects, Navigable waters, Prescriptive rights, Hunting, Fishing, Riparian land, Legislation, Land use.
Identifiers: Dedication, Estoppel.

The state of Minnesota petitioned for condemnation of a tract of land adjoining a lake, proceeding under a statute which allowed the state to acquire parking or camping areas adjacent to public waters. The owner of the riparian land contended the lake was not a public body of water. The trial court dismissed the petition and on appeal the dismissal was affirmed. Under Minnesota law, whether or not a body of water is public depends on whether it was navigable when Minnesota entered the Union in 1858. In this case the court indicated that the public might be able to acquire the right to hunt and fish through dedication or possibly through prescription or estoppel even though the lake was not navigable at the time of admission of Minnesota to the Union. Dedication can be implied from certain actions by the owner; however, the cases indicate that the right to hunt or fish cannot be acquired by dedication. Early decisions do not recognize a public right to acquire an interest in realty through prescription. Most jurisdictions now hold that acquiescence by an owner for a period equal to the statute of limitations creates a presumption of either prior dedication or prior condemnation. No decisions have been found which even consider the estoppel aspects of the public right to hunt or fish. The best solution would be a statutory enactment providing that after a period of use by the public, an easement will be presumed to have been dedicated to the public for hunting and fishing. (Heckerling-Florida)
W70-00089

EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.

Harv L Rev, Vol 61, No 5, p 882-884, May 1948. 3 p.

Descriptors: *Eminent domain, *Drainage, *Compensation, *Navigable waters, Non-navigable waters, Judicial decisions, Dams, Federal government, Damages, Rivers, Tributaries, Construction, Condemnation, Mississippi River, Legal aspects.

Plaintiff's use of his land for farming depended on the drainage of surface and underground waters into a non-navigable stream which emptied into the Mississippi River about a mile below plaintiff's farm. Construction of a dam on the Mississippi by the United States raised the normal water level of the tributary, preventing drainage from plaintiff's land. Plaintiff sued in the Court of Claims on the theory of an implied promise by the United States to pay for private property taken for public use without formal condemnation proceedings. The court held that the injury to plaintiff's land was compensable under the eminent domain clause of the Fifth Amendment. Actions like this must be brought under the Fifth Amendment to recover for the 'taking' of property since the government's sovereign immunity prevents suit in tort. In defining a 'taking,' the courts have been influenced by conflicting desires. On one side there is the feeling that public funds should respond for injuries to individuals by public agencies; on the other side, the courts have tried to avoid discouraging public improvements by burdening them with unpredictable and illimitable liabilities. (Heckerling-Florida)
W70-00092

COUNTY BRIDGE CONSTRUCTION.
For primary bibliographic entry see Field 06E.
W70-00108

TOWNSHIPS AND COUNTY LINE BRIDGES.
For primary bibliographic entry see Field 06E.
W70-00109

SEWERS AND DRAINS IN CITIES AND TOWNS.
For primary bibliographic entry see Field 06E.
W70-00113

INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
For primary bibliographic entry see Field 06E.
W70-00114

INDIANA PORT COMMISSION.
For primary bibliographic entry see Field 06E.
W70-00116

WATERCOURSES - CANALS - TOLL BRIDGES.
For primary bibliographic entry see Field 06E.
W70-00122

PROTECTION OF LAKES.
Ind Ann Stat secs 27-601 thru 27-659 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Water management (Applied), *Water levels, *Drainage systems, Water loss, Water level fluctuations, Drainage practices, Dams, Dam construction, Lakes, Riparian rights, Riparian water loss, Lake shores, Water pollution, Construction costs, Fresh water, Assessments, Legislation, Legal aspects, Artificial watercourses.
Identifiers: Penalties (Civil).

The protection of water levels of public fresh-water lakes includes restrictions on unauthorized drainage works, dam and levee construction, and interference with fresh-water outlets and spillways of any lake. The application of this act is restricted to natural and artificial fresh-water lakes. The Department of Conservation is given authority for strict control over all drainage works, lake water level stabilization improvements, and sewage disposal facilities. Procedures are available to lake shore land owners, counties, and the Department to petition the courts for leave to make lake and drainage improvements, the costs of which are to be ultimately assessed against the respective petitioners. (See also W70-00124 thru W70-00127). (McDonough-Florida)
W70-00123

WATER LEVEL PROTECTION.

Ind Ann Stat secs 27-601 thru 27-619 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Water management (Applied), *Water levels, *Drainage systems, Dams, Dam construction, Drainage practices, Levees, Bank protection, Lakes, Flood control, Water loss, Riparian rights, Ditches, Spillways, Fresh water, Lake Michigan, Legislation, Legal aspects.
Identifiers: Injunctions (Prohibitory), Penalties (Civil).

The Department of Conservation must approve any drainage works or change or destruction of any bank, dam, or levee that would change the water level of a public fresh-water lake. The construction of any drainage works within one hundred sixty rods of any fresh-water lake is restricted unless a dam is constructed to protect the water level of the lake. It is unlawful to lower more than twelve inches the level of any lake having more than twenty acres. This act does not apply to city water reservoirs, electrical generator water supplies, or to the waters of Lake Michigan. The Department may employ injunctive relief to restrain unauthorized construction or drainage. Violations of this act are a misdemeanor. (See W70-00123). (McDonough-Florida)
W70-00124

WATER LEVEL PROTECTION.

Ind Ann Stat secs 27-620 thru 27-628 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Water management (Applied), *Water level, *Lake shores, Water pollution, Sewage, Excavation, Drainage, Drainage systems, Dams, Spillways, Flood protection, Landfills, Land forming, Lakes, Ditches, Legislation, Legal aspects, Administrative agencies, Regulation, Construction.
Identifiers: Injunctions (Prohibitory).

The Department of Conservation may prohibit the commencement of any project on any public fresh-water lake that will affect or is likely to affect a lowering of the water level. Written approval from the Department must be obtained prior to the encroachment on the lake level or shoreline by excavating, filling in, or otherwise changing the size or contour of a lake. The State Board of Health and/or the Stream Pollution Control Board must give written approval for the construction of sewage disposal facilities for housing developments of five or more lots where such a development is a part of any change in shoreline. The Department shall establish the average normal water level of all lakes, erect appropriate monuments designating the normal average water level, and sponsor the construction of dams, spillways, and control works necessary to maintain that level. The natural resources and scenic beauty of Indiana lakes is a public right. Both citizens and the Department may seek injunctive relief to restrain violations of this act. (See W70-00123). (McDonough-Florida)
W70-00125

WATER LEVEL STABILIZATION.

Ind Ann Stat secs 27-629 thru 27-645 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Riparian rights, *Water levels, *Water management (Applied), Riparian water loss, Construction costs, Costs, Assessments, Lakes, Dams, Bids, Water level fluctuations, Drainage, Drainage systems, Water loss, Legislation, Legal aspects, Administrative agencies, Surveys.
Identifiers: Public need.

When at least twenty percent of owners of land abutting upon or within four hundred forty yards of the shore or water line of any lake of ten or more acres, or when the Department of Conservation or board of commissioners of any county in which the lake is located desire to stabilize or raise the lake level, they may petition the appropriate court. The form and content of the petition must follow the requirements of law and allege a public need. If the petition is granted, a surveyor is hired to supervise the improvement and determine appropriate assessments for the costs of the improvement. Objection to the petition or the assessments must be timely filed. Costs and expenses of the improvement shall come out of the county general fund or the general lake improvement fund. (See W70-00123). (McDonough-Florida)
W70-00126

WATER LEVEL PROTECTION (LAKES).

Ind Ann Stat secs 27-646 thru 27-659 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Construction costs, *Drainage systems, *Water levels, Legal aspects, Dam construction, Ditches, Landfills, Land forming, Costs, Riparian rights, Lake shores, Administration, Lakes, Lake Michigan, Assessments, Accretion (Legal aspects), Legislation, Administrative agencies.
Identifiers: Penalties (Civil).

Each county may establish a general lake improvement fund. The surveyor in charge of a lake improvement project must compute the costs of the project, apportion the costs against the land benefited, establish a time for payment of assessment, and publish notice of assessments as liens on the land. Failure of the surveyor to faithfully discharge his duties is a misdemeanor. Petitions for the construction of drainage works within the proscribed distance of a lake may ask that abutting landowners, the Department of Conservation, or the appropriate county participate in the costs of the project. No accretional rights accrue to riparian owners by the lowering of any lake water level by drainage or by extending the shoreline out into the water by filling without the written approval of the Department. The State Board of Health must approve all proposed sewage disposal facilities. Lake Michigan is not affected by this act. (See W70-00123) (McDonough-Florida)
W70-00127

MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.
For primary bibliographic entry see Field 06E.
W70-00129

RESERVOIR SITES FOR STORAGE OF WATER.
For primary bibliographic entry see Field 06E.
W70-00130

INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
For primary bibliographic entry see Field 06E.
W70-00131

CONSTRUCTION OF DRAINS.
For primary bibliographic entry see Field 06E.
W70-00132

DRAIN IMPROVEMENT.
For primary bibliographic entry see Field 06E.
W70-00133

RIVER IMPROVEMENTS BY THE UNITED STATES.
For primary bibliographic entry see Field 06E.
W70-00134

CONSERVATION DEPARTMENT.
For primary bibliographic entry see Field 06E.
W70-00136

HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 02E.
W70-00137

ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).

20 NJ 320, 120 A2d 4-10 (1955).

Descriptors: *New Jersey, *Repulsion (Legal aspects), *Drainage water, *Reasonable use, Judicial decisions, Riddance (Legal aspects), Surface runoff, Surface waters, Floods, Streamflow, Riparian rights, Percolating water, Natural flow doctrine, Erosion, Flood damage, Diversion, Relative rights, Alteration of flow, Flow augmentation.
Identifiers: Civil law rule.

Plaintiff owned land downstream from defendant. Defendant land developer and contractor caused surface and percolating waters from the developed land to be artificially gathered and discharged into the natural stream. The increase in water flow and the deposit of silt from the greater water volume damaged plaintiff's property. Plaintiff brought an action to compel defendant to pipe this water to a discharge lake below his property. Three rules of liability for the casting of surplus surface water onto the land of another have developed: (1) the common enemy rule allows the landowner unrestricted privilege to rid his land of water; (2) the civil law rule imposes liability on anyone who interferes with the natural flow of water so as to cause damage; (3) the reasonable use rule allows the landowner to make reasonable use of his land even though the flow is altered and causes some harm. The court adopted the last rule and found that the defendant's use of his land was unreasonable when weighed against the harm to plaintiff's property. Defendant was held liable for damages. (Helwig-Florida)
W70-00169

ACCRETION - A NEW SLANT,
Warren M. Salomon.
U Miami L Rev, Vol 17, No 3, p 417-420, Spring 1963. 4 p, 17 ref.

Descriptors: *Florida, *Accretion (Legal aspects), *Land tenure, *Access routes, Judicial decisions, Legal aspects, Beds under water, Gulf of Mexico, Shores, Islands, Boundaries (property), Riparian land, Ownership of beds.

In Ford v Turner, 142 So 2d 335 (2d D.C.A. Fla. 1962), plaintiff and defendant were owners of adjacent tracts of land on the Gulf of Mexico. The lands were separated by a channel. Over a period of years, plaintiff's land had increased in size, growing out into the Gulf over sovereign land until it extended in front of, but did not touch, defendant's land. The result was that defendant's land was almost completely blocked from the Gulf. The court held that accretions belong to the land to which they are joined, regardless of the fact that they also extend in front of other lands. The law as regards accretions has been settled for a long time. Most courts hold that accretions belong to the owner against whose land they form. Division of accretions is done with an attempt to: (1) keep the same proportional share in the new land that the parties had in the old, and (2) allow each party to retain his access to the water. The court must necessarily give due consideration to the correlative rights of adjoining upland owners. The court in the instant case applied rules of law formerly used only in determining ownership of accretions in rivers, not along the seashore. If the court is correct, ingress and egress rights will now be determined by ownership of the submerged land. (Heckerling-Florida)
W70-00170

GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
For primary bibliographic entry see Field 04C.
W70-00176

TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
H. J. Lawford.
The Canadian Bar Review, Vol 39, No 4, p 577-602, Dec 1961. 26 p, 89 ref.

Descriptors: *Treaties, *International law, *Navigation, *St Lawrence River, St Lawrence Seaway, Great Lakes, Canals, Fishing, Commercial fishing, Transportation, Tariffs, Navigable waters, Navigable rivers, International waters, Legislation, Legal aspects.

Recent announcements indicate that the Canadian government intends to restrict the Great Lakes and St Lawrence coasting trade to vessels of Canadian registry. Current legislation also requires compulsory pilotage on these waters. Such policy statements must be considered in light of Canadian treaty obligations containing national treatment clauses, most-favored nation clauses, and direct grants of navigation and cabotage rights. Treaty provisions concerning freedom of transit on the St Lawrence and Canadian canals and coastal fishing will be seriously impaired if Canada does not intend to respect her international committments. (McDonough-Florida)
W70-00180

EXTENT OF PRIVATE RIGHTS IN NON-NAVIGABLE LAKES,
J. W. Cullis.
U Fla L Rev, Vol 5, No 2, p 166-179, Summer 1962. 14 p, 67 ref.

Descriptors: *Florida, *Riparian rights, *Lakes, *Ownership of beds, Nonnavigable waters, Judicial decisions, Federal government, State governments, Legal aspects, Beds under water, Land tenure, Water users, Public lands, Grants, Navigable waters, Riparian land, Overlying proprietor, Relative rights, Riparian waters, Water utilization.
Identifiers: Common law, Civil law.

With the discovery of oil deposits, title to subaqueous property is growing in importance to landowners whose property borders on lakes. In Florida any determination of the rights to waters or submerged lands depends on the question of navigability. If a lake is 'navigable' under the federal definition of the term, then the bed of the lake is held to have passed to the state on its admission to the Union and the state holds the bed in public trust. If a lake is nonnavigable, the bed may pass freely to private owners. Where land bordering a nonnavigable lake is deeded by the state or federal government, state law determines whether the grant carries title out to the center of the lake. The Florida courts will probably follow the majority view and permit private ownership of submerged land to the center of the lake. As yet the Florida courts have not determined the extent to which a bed owner has the right to use the lake overlying his land. Under the common law he may use only immediately overlying his fee; however, under the civil law approach he may use the entire surface of the lake as long as he does not unduly interfere with the rights of the other proprietors. When the question does arise before the Florida courts, adoption of the civil law view will best serve the interests of Florida. (Heckerling-Florida)
W70-00182

RIPARIAN RIGHTS IN GEORGIA,
William H. Agnor.
Ga B J, Vol 18, No 4, p 401-414, May 1956. 14 p, 54 ref.

Descriptors: *Georgia, *Riparian rights, *Reasonable use, *Non-navigable waters, Prior appropriation, Natural flow doctrine, Alteration of flow, Competing uses, Diversion, Industrial water, Irrigation, Irrigation water, Legal aspects, Municipal water, Natural use, Obstruction to flow, Riparian waters, Water pollution, Legislation, Water policy, Permits, Relative rights.

This consideration of the present status of the law regarding riparian rights in non-navigable streams is based on a review of all of the case and statutory material in Georgia. Emphasis is placed on the right of riparian owners to use the water of streams. Generally, each riparian owner is entitled to a reasonable use of such water so long as this use does not adversely affect the natural course of the stream or the rights of other riparian owners. The varying circumstances in each case are used to determine what use is reasonable. Three theories of water law are discussed: (1) the doctrine of riparian rights; (2) the doctrine of prior appropriation; and (3) reasonable use. Each of these theories has its strengths and weaknesses in relation to the three pressing problems of water law. They are: (1) pollution; (2) use of water for irrigation; and (3) use of water by industry and municipalities. The author believes that the present doctrine of riparian rights in Georgia can be adequately modified to meet these problems and makes basic suggestions as to how this can be accomplished. (Schram-Florida)
W70-00183

FLOOD CONTROL AND WATER USAGE.
Ky Rev Stat Ann secs 104.020-104.160 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Flood control, *Flood protection, *Control structures, Legislation, R regulation, Administration, Floods, Flood routing, Dikes, Floodgates, Levees, Water control, Dams, Diversion, Diversion structures, Flood proofing, Operation and maintenance, Financing, Legal aspects, Administrative agencies, Cities, Local governments.

Regulations concerning the power of cities to establish flood control systems and to acquire property for same together with provisions concerning which administrative agency will control the flood control system, payment of expenses, and condemnation provisions are set forth. Certain aspects of the cost of the flood control system may be paid for out of bond revenue. Benefited property shall be assessed to support the operation and maintenance fund. Provisions for collection of delinquent assessments and court review are included. (Moulder-Florida)
W70-00189

NAVIGABLE WATERWAYS.
Ind Ann Stat secs 68-101 thru 68-109 (1961).

Descriptors: *Indiana, *Streams, *Navigation, *Obstruction to flow, Legislation, Legal aspects, Administrative agencies, Riparian rights, Beds, Piers, Docks, Mills, Dams, Aqueducts, Bridges, Barriers, Public benefits, Navigable waters, Navigable rivers, Surface waters, Riparian waters.
Identifiers: *Navigable watercourses, Penalties (Criminal).

Boards of county commissioners may declare any watercourse within their county a navigable watercourse upon petition of twenty-four freeholders. When a petition is made, the commissioners will have the watercourse examined to ascertain whether the watercourse is navigable and of public utility; if so, the watercourse is declared navigable. Twice yearly navigable watercourses are cleared of obstructions under the supervision of the road district supervisor for the district in which the stream is located. Penalties are provided for the obstruction of navigable watercourses. Riparian owners may build structures into navigable watercourses, but not so far out as to obstruct navigation. Mills, dams, aqueducts, viaducts, bridges, and machinery on watercourses will not be affected by designation of the watercourse as navigable. Persons living on or owning property along any watercourse that is navigable for large boats are authorized to hang gates at or near the top of the bank, or across any road leading down the bank and terminating at such watercourse, except within the limits of towns and cities. The Kankakee River is declared a navigable stream. (Keith-Florida)
W70-00191

CHICAGO REGIONAL PORT COMMISSION.

Ind Ann Stat secs 68-301 thru 68-305 (1961).

Descriptors: *Port authorities, *Lake Michigan, *Indiana, *Illinois, Interstate commissions, Great Lakes region, Multiple-purpose projects, Resource development, Navigation, Optimum development plans, Feasibility studies, Transportation, State governments, Programs, Harbors.
Identifiers: Chicago.

The Chicago regional port commission was established to investigate and report upon the feasibility of establishing a permanent interstate port authority within the metropolitan district embraced by the Lake Michigan shore line, with recommendations as to membership of the governing body, proposed method of appointment, duties and powers, jurisdiction, and probable expenses involved in maintenance of such port authority. In addition, the commission was given the authority to study, prepare information, and make recommendations with the ultimate goal of bringing into existence a full development of said district's water transportation facilities so as to lead to a revival of said district as a center of water transportation in realization of the natural advantages of this community. Fifteen thousand dollars was appropriated to pay expenses incurred by the commission. This was to be used to pay the actual expenses of the commissioners and pay for the employment of necessary engineering, legal, and clerical assistants. This act was to take force only upon the passage of equal appropriations by the state of Illinois. (Schram-Florida)
W70-00192

PORT AUTHORITIES.

Ind Ann Stat secs 68-1001 thru 68-1020 (1961), as amended, (Supp 1968).

Descriptors: *Indiana, *Port authorities, *Construction, *Channel improvement, Lakes, Harbors, Construction costs, Bulkheads, Transportation, Inland waterways, Financing, Costs, Taxes, Eminent domain, Right-of-way, Contracts, Bids, Legal aspects, Water law, Legislation, Local governments, Cities, Navigation, Planning, St. Lawrence Seaway.

This is an emergency measure to permit the prompt organization of port authorities to take advantage of the St. Lawrence Seaway project. Municipalities, counties, or both may create port authorities having jurisdiction in all territories of the creating subdivision. Prior to the taking of any municipality's property, a county seeking to create a port authority must compensate the municipality in full in an amount equal to the waterfront investments of such municipality. The port authority is governed by a board of directors. The powers of the port authority include the power to: (1) purchase, construct, sell, lease, and operate docks, warehouses, and other port facilities; (2) improve channels, rivers, and streams necessary to the port; (3) acquire real or personal property; (4) recommend the issuing of revenue bonds to cover costs; (5) sell, lease, or contract for natural or mineral resources of land owned by the port authority; and (6) exercise the rights of eminent domain, right-of-way, easements, and others. The construction and use of port facilities by private enterprise is encouraged. A channel maintenance fund financed by ad valorem taxes of real and personal property may be established upon the approval of the State Tax Commission. (McDonough-Florida)
W70-00194

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
Ind Ann Stat secs 11-11-1 thru 11-1112 (1956).

Descriptors: *Indiana, *Dams, *Obstruction to flow, *Fish conservation, Legislation, Legal aspects, Rivers, Streams, Ponds, Reservoirs, Lakes, Fish stocking, Fishing, Cities, Impounded waters, Canals, Outlets, Investigations, Administrative agencies, Regulation, Illinois, Ohio River, Weirs, Nets, Pumps, Lake Michigan, Flow control, Flow, Administration, Fish, Fish management, Water policy, Water conservation.

Identifiers: *Public use, *Natural waterbodies, Penalties (Criminal), Wabash River.

Any person owning, operating or controlling any dam or other obstruction across any watercourse in the state must permit a flow of water through same sufficient to maintain fish in the watercourse below such dam or other obstruction; such persons must also keep a sufficient amount of water in the pond, reservoir, or lake above such dam or other obstruction to maintain fish. The provisions of this act do not apply to water impounded for municipal uses or to the Ohio and specified portions of the Wabash Rivers. Persons violating this act are subject to criminal penalties. It is the duty of the Conservation Department to make appropriate investigations persuant to their power to enforce and administer the provisions of this act. The conservation department may construct and maintain weirs and nets in natural bodies of water to insure that game fish liberated therein will not escape to water not open to the public for fishing. All pumps and machinery used to pump water out of Lake Michigan must be designed so as to prevent the killing of fish. (Keith-Florida)
W70-00195

LEVEE AUTHORITY DISTRICTS.

Ind Ann Stat secs 27-1001 thru 27-1033 (1960).

Descriptors: *Indiana, *Flood control, *Administrative agencies, *Levees, Flood protection, Water control, Drainage districts, Drainage, Local governments, Planning, Financing, Construction, Eminent domain, Legal aspects, Dams, Ditches, Easements, Legislation, Taxes, Dikes.
Identifiers: Penalties (Criminal).

Cities within counties of a specified population range may establish Levee Authority Districts for the purpose of acquiring land and easements upon which to construct, improve, maintain, and regulate levees. Each Levee Authority District is governed by a board having executive and legislative powers for the District. Board members may not hold appointive office, be employed by the District, or have an interest in any contract with or claim against the district. The board may: (1) propose and adopt ordinances; (2) sue and be sued; (3) adopt an annual budget and levy taxes; (4) incur debts; (5) adopt rules and regulations; (6) acquire realty and personalty; (7) sell any unneeded property; (8) construct, maintain and repair levees, dikes, break waters, pumping stations, flood gages, sewers, ditches, and diversion channels as necessary; (9) enter into contracts; (10) exercise the power of eminent domain; and (11) issue general obligation bonds of the district. The construction and operation of levees under this act is declared to be a governmental function of general public necessity. Violations of this act or of regulations and ordinances enacted pursuant thereto are misdemeanor. (McDonough-Florida)
W70-00197

FLOOD CONTROL SYSTEMS.

Ky Rev Stat Ann secs 104.200-104.380 (1963).

Descriptors: *Kentucky, *Financing, *Flood control, *Cities, Costs, Legislation, Regulation, Administration, Flood protection, Dams, Drains, Dikes, Levees, Water control, Diversion structures, Control structures, Economic feasibility.

All fourth class cities may establish a flood control system. The city may acquire necessary land within or without the city by gift, purchase, or condemnation. The city may secure funds by the issuance of bonds payable from the proceeds of an annual property tax and from special assessments. The method of establishing the system, including resolutions, hearings, objections or protests, and adoption of the final ordinance setting up the system is set forth. The system may be constructed by contract or by the city itself. (Moulder-Florida)
W70-00200

INVESTIGATION OF BRAHMAPUTRA RIVER,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
For primary bibliographic entry see Field 02E.
W70-00219

DRAINAGE IMPROVEMENT DISTRICTS; REMOVAL OF STREAM OBSTRUCTIONS.

Ill Ann Stat ch 24, secs 11-111-1 thru 11-111-10, 11-111.1-1 (Smith-Hurd 1962).

Descriptors: *Illinois, *Surface drainage, *Drainage engineering, *Obstruction to flow, Legislation, Legal aspects, Drainage districts, Drainage, Cities, Overflow, Rivers, Public health, Taxes, Assessments, Surveys, Construction, Structures, Embankments, Levees, Dikes, Natural streams, Flood protection, Financing, Watercourses, Landfills, Grading, Environmental sanitation, Standing waters.

When a city is wholly or partially subject to overflow and wholly or partially surrounded by levees, dikes, or embankments, to prevent overflow it may: (1) divide the city into improvement districts; (2) fix the grade of the streets or public grounds at any height deemed necessary to give a surface drainage to the river which causes the overflow; and (3) require low lots, blocks, or parts thereof to be filled in such a manner as to prevent water from standing thereon and thus to prevent them from becoming a nuisance or injuriouis to the public health. Methods of survey for cost estimates of necessary construction and of financing are specifically set out. City authorities may remove any obstructions from natural and other watercourses which cause the flooding of any part of the city, regardless of where such obstructions are located. (Keith-Florida)
W70-00225

PEAT AND MUCK DRAINAGE PROBLEMS,
Agricultural Research Service, Athens, Ga. Southeast Watershed Research Center.
John C. Stephens.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR2, Pap 6603, p 285-305, June 1969. 21 p, 13 fig, 23 ref.

Descriptors: *Droughts, *Drainage, *Drying, *Peat, *Muck soils, *Florida, Ecology, Conservation, Swamps, Subsidence, Organic soils, Dehydration, Oxidation, Burning, Land subsidence, Water table, Water level fluctuations, Erosion.
Identifiers: *Everglades.

Drainage of organic soils results in lowering of the surface (subsidence) by shrinkage due to drying, loss of the buoyant force of groundwater, compaction, wind erosion, burning, and biochemical oxidation. The relative effect of each of these factors depends on soil origin, land-management practices, and climate. The total subsidence rate is proportionate to depth of drainage--the lower the water table, the greater the soil loss. In the Florida Everglades the largest losses have been due to biochemical oxidation. With continued subsidence these organic soils will be too shallow for agriculture by the year 2000. Here, drainage has permitted sea water to move inland contaminate the Biscayne aquifer, and has also changed the original ecology of the Evergiades area to the detriment of wildlife. Recent water-management programs (1945-68) have ameliorated the consequences of overdrainage. Subsidence of organic soils with drainage occurs worldwide with observed rates up to 3 inches annually. To obtain maximum use of organic soils, drain only those lands that are potentially arable, place drained lands into productive use quickly, and hold water tables as high as crop and human requirements permit. (Knapp-USGS)
W70-00229

MILLS AND MILL DAMS.

Ark Stat Ann secs 35-501 thru 35-526 (1962).

Descriptors: *Mill dams, *Riparian rights, *Flood damage, *Arkansas, Dams, Structures, Mills, Dam construction, Legislation, Damages, Damsites, Fish barriers, Alteration of flow, Canals, Conveyance structures, Overflow, Navigable waters, Engineering structures, Maximum probable flood, Relative rights, Legal aspects, Adjudication procedure.

Any person may erect a dam across a non-navigable watercourse if he owns the land through which such watercourse runs. If water is likely to overflow onto another's land, the person proposing to erect the dam must petition the circuit court for authorization. A jury examines the site and finds estimated damage, type of property that will be inundated, obstructions to fish and navigation, and dangers to health that might ensue. If the builder owns only one side of the stream, he must follow similar proceedings. In addition, he must compensate the owner of land on the opposite side for the equivalent value of one acre of land. This value is determined by the viewing jury. Property-owners subject to damage and the opposite landowner must appear before the court, which considers their testimony together with the inquest returned by the jury in passing on the petition. The order is conditioned upon making provisions for fish passage, payment of damages and valuations, and immediate commencement of work. If the dam is damaged, repairs must be made within three years. The inquest does not bar unforseen damages, and double damages are recoverable if provisions of this act are violated. Similar procedures are followed for cutting a canal through another's property. (Douberley-Florida)
W70-00245

THE CONTROL OF WATER WEEDS.
Agricultural Research Council, Kidlington (England). Weed Research Organization.
For primary bibliographic entry see Field 05G.
W70-00269

COUNTY LINE BRIDGES.

Ind Ann Stat secs 36-2001, 36-2002 (1949).

Descriptors: *Indiana, *Bridge construction, *Local governments, *Boundaries (Property), Bridges, Repairing, Streams, Legislation, Cost repayment, Construction, Cost allocation, Construction costs, Public benefits.

When public convenience shall require the erection, repair, or purchase of any bridge across a stream forming the boundary-line between two or more counties, the board of commissioners of either county may declare its willingness to aid in such improvement. Whenever the other county or counties' board of commissioners declare a like willingness, such improvement may be begun by agreement between the counties. If any county refuses to aid in such improvements, then the improvements may be made by the willing county alone if in its opinion the public convenience requires it. If the cost of such bridge or repairs does not exceed $10,000, the county making such improvements may recover the amount which the benefited county should have paid had it joined in the improvements. Each county shall be regarded as owner of an interest in any bridge provided for in this section and shall have a voice in regulating the use thereof. (Smith-Florida)
W70-00336

EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
Ohio Agricultural Research and Development Center, Wooster; and Agricultural Research Service, Columbus, Ohio.
For primary bibliographic entry see Field 03F.
W70-00351

TOWNSHIP LINE BRIDGES.

Ind Ann Stat secs 36-2201 thru 36-2220 (1949).

Descriptors: *Indiana, *Bridge constuction, *Local governments, *Boundaries (Property), Cities, Bridges, Streams, Legislation.

Upon petition of twenty-five freeholders of any township asking the board of commissioners of the county to allow the township to aid another township in contructing a bridge across a stream which forms the boundary between the townships, an election shall be held to determine whether or not an appropriation shall be made for such construction. If a majority of the votes in each township are cast in favor of the bridge construction, the board of commissioners shall levy a special tax and begin construction. If one of the boards of commissioners fails to act, then the other county may construct the bridge alone and assert a claim against the delinquent county. (Smith-Florida)
W70-00354

BRIDGES OVER CANALS.
Ind Ann Stat secs 36-2301 thru 36-2309 (1949).

Descriptors: *Indiana, *Bridges, *Canals, *Highways, Bridge construction, Local governments, Legislation, Repairing, Legal aspects.

Whenever any canal company is required by law to build or repair any bridge where such canal crosses any public road or street, the boards of commissioners have a duty to bring suit against such company for failure to construct or repair such bridge. When any canal company's charter requires it to build a bridge for a highway constructed across the canal, then the state highway commissioner shall require that such construction be made. Upon default of the canal company, the commissioner shall proceed to construct the bridge and charge the costs to the canal company. (Smith-Florida).
W70-00355

LEVEE CONSTRUCTION AND MAINTENANCE.
Ind Ann Stat secs 48-4601 thru 48-4604 (1963), as amended, (Supp 1968).

Descriptors: *Indiana, *Levees, *Flood control, *Construction, Legislation, Legal aspects, Administrative agencies, Maintenance, Surveys, Contracts, Right-of-way, Taxes, Cities, Jurisdiction, Eminent domain, Flood control, Flood protection, Financing.
Identifiers: Cost estimates.

When the Board of Public Works of certain specified classes of cities is of the opinion that the construction, maintenance, repair, or improvement of any levee is necessary for the protection of the city, such Board may cause surveys and estimates of the cost thereof to be made. Methods of financing, letting contracts, and acquiring lands for the construction or maintenance of levees are specifically provided. For purposes of this act the term 'city' includes towns and the term 'Board' includes any municipal department of a city which performs the duties of a Board of Public Works. The Board of a city may appropriate land to construct a levee for the purpose of flood prevention, and it may simultaneously plan for the construction of a street thereon. (Keith-Florida)
W70-00367

INTERSTATE BRIDGES.

Ind Ann Stat secs 36-2401 thru 36-2469 (1949), as amended, (Supp 1968).

Descriptors: *Indiana, *Bridge construction, *Administration agencies, *Interstate rivers, Legislation, Taxes, Costs, Operating costs, Rivers, Streams, Condemnation, Construction, Operation and maintenance, State governments, Highways, Construction costs, Tax rate, Contracts, Interstate commissions, Interstate compacts, Bridges, Interstate, Cities, Railroads, Financing.
Identifiers: *Interstate bridges, Tolls.

Indiana counties and municipalities bordering on state-line rivers or streams are authorized to cooperate with subordinate divisions of adjoining states in building and maintaining bridges across such waters and to pay one-half the expenses thereof. The act includes provisions for: (1) petitioning, levying of taxes, bonding, and appropriation; (2) creating county bridge commissions; (3) creating temporary and permanent joint commissions formed with commissions of another state; (4) purchasing and condemning lands and rights; (5) changing the location of obstructions impeding work; (6) operating bridges; (7) tolls; (8) bridge construction and control, by county bridge commissions, independent of the authorities of an adjoining state; and (9) disbursements by bridge commissions. The Indiana State Highway Commission is authorized to construct state-line bridges, and provisions are made for: (1) bridge location; (2) estimation of costs and the issuance of bonds; (3) a tax levy; (4) bridge maintenance; (5) tolls; and (6) interstate contracts. Provision is also made for the purchase of state-line bridges by cities for public aid to corporations erecting such bridges and for the use of such bridges by railroad companies. (Marsee-Florida)
W70-00373

INTERSTATE BRIDGES.

Ind Ann Stat secs 36-2401 thru 36-2410 (1949).

Descriptors: *Indiana, *Bridge construction, *Administrative agencies, *Interstate commissions, Legislation, Contracts, Operation and maintenance, Costs, Streams, Rivers, Construction, State governments, Construction costs, Taxes, Tax rate, Interstate rivers, Interstate compacts, Bridges, Interstate, Financing, Local governments.
Identifiers: *Interstate bridges.

Indiana counties and municipalities bordering on state-line rivers or streams are authorized to cooperate with subordinate divisions of adjoining states in building and maintaining bridges across such waters and to pay one-half the expenses thereof. Such county may, upon petition of resident property holders, levy a property tax for the building and maintaining of such bridges. The board of commissioners of such county is empowered to plan, construct and maintain these bridges and is authorized to appoint a bridge commission. Such commission may, in conjunction with commissions from adjoining states, establish a temporary joint commission with the following duties and powers: (1) to contract; (2) to use and be sued; (3) to elect officers; (4) to establish rules, regulations and by-laws for its conduct; (5) to employ necessary employees; (6) to have plans and specifications for bridge construction and location prepared; (7) to build and equip the entire bridges and approaches thereto; and (8) to map and survey all Indiana land, structures, rights-of-way, easements and other interests, including under water and riparian rights, the acquisition of which may be deemed necessary to construct such bridges. (Marsee-Florida)
W70-00374

INTERSTATE BRIDGES.

Ind Ann Stat secs 36-2411 thru 36-2421 (1949).

Descriptors: *Indiana, *Bridge construction, *Administrative agencies, *Interstate commissions, Interstate rivers, Legislation, Rivers, Streams, Condemnation, Construction, Costs, Contracts, Operation and maintenance, State governments, Construction costs, Interstate compacts, Interstate, Financing.
Identifiers: *Interstate bridges, Tolls.

Temporary joint commissions, formed by Indiana bridge commissions and similar commissions from adjoining states, may purchase such Indiana land interests as shall be necessary to construct interstate bridges. Condemnations shall be had in the name of the Indiana Bridge Commission. The Commission may require the relocation or removal of obstructions impeding bridge construction. Upon completion of the bridges for which they were created, the Indiana and temporary joint commissions shall cease to exist. A permanent joint commission shall be formed with powers and duties: (1) to sue and be sued; (2) to contract; (3) to operate and control such bridges; (4) to pay over excess net earnings from such bridges to the taxing districts of each state; and (5) to regulate rates, charges, and tolls for the use of such bridges. The interstate bridges may be built, paid for, and maintained by Indiana commissions independently of any adjoining state. In such case, the Indiana commission shall be vested with all the powers and duties devolved upon the temporary and permanent joint commissions. Provisions concerning bridge construction bonds are set forth. (Marsee-Florida)
W70-00375

INTERSTATE BRIDGES.

Ind Ann Stat secs 36-2422 thru 36-2455 (1949).

Descriptors: *Indiana, *Bridge construction, *Administrative agencies, *Highways, Legislation, Taxes, Costs, Operating costs, Rivers, Streams, Construction, Operation and maintenance, State governments, Construction costs, Tax rate, Contracts, Interstate, Financing, Regulation, United States, Legal aspects.
Identifiers: *Interstate bridges, Tolls.

The Indiana State Highway Commission is authorized to construct and maintain highway bridges over interstate rivers and streams whenever such bridge or any part thereof, including approaches, will be within Indiana. Such bridge may be constructed at any point, subject to the approval of the proper authorities of the United States, and the Commission may build any necessary part of such bridge within the territorial limits of another state. The Commission is also authorized to negotiate and contract with the adjoining state for the procurement of the right to build, maintain, and operate such bridges. The Commission shall submit an estimate of the cost of such bridge to the auditor of the county where the bridge is to be located, and that county shall issue bonds for such construction as provided herein. The county shall also levy an annual property tax to meet the principal and interest of bonds. Subject to a grant of authority from the United States, the Commission shall charge toll for the use of such bridges and shall fix the rates of such toll. The Commission shall also make rules governing the use of said bridges. (Marsee-Florida)
W70-00376

INTERSTATE BRIDGES.

Ind Ann Stat secs 36-2456 thru 36-2469 (1949), as amended, (Supp 1968).

Descriptors: *Indiana, *Bridge construction, *Administrative agencies, *Interstate rivers, Legislation, Taxes, Costs, Construction costs, Rivers, Streams, Condemnation, Construction, Highways, Contracts, Interstate compacts, Bridges, Cities, Railroads, Financing, Local governments.
Identifiers: *Interstate bridges, Tolls.

The Indiana State Highway Commission may cooperate and contract with adjoining states to provide payment for the construction of interstate bridges. Such payment is not to exceed one-half the cost of construction. Any city of Indiana or an adjoining state may purchase shares of stock in any interstate-bridge company or corporation. Any city holding four-fifths of all shares in such company, and unable to agree with the other share owners on the purchase of the remaining shares, may con-

demn and appropriate such shares for public use. Such bridge shall then become the property of such city. Counties and townships wherein an interstate bridge may be located may take stock in or make donations to corporations erecting such bridges, and cities may guarantee the payment of bonds of any such company. All railroads shall have the right to use any bridge constructed under this act, and terms as to toll and rates shall be set by agreement with the company operating the bridge or by the circuit court. To provide for a cumulative bridge fund, county commissioners, town boards, and city councils may levy a tax on personal and real property. (Marsee-Florida)
W70-00377

ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.

Iowa Code Ann secs 455.12, 455.17, 455.18 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Engineering, *Project planning, *Drainage districts, Legislation, Legal aspects, Levees, Administrative agencies, Ditches, Drains, Basins, Public benefits, Surveys, Public health, Settling basins.

The board of supervisors shall appoint a disinterested and competent civil engineer who shall give bond to the county for the use of the proposed levee or drainage district. The engineer shall examine the lands described in the petition and any other lands which would be benefited by said improvement or necessary in carrying out the same. He shall locate and survey such ditches, drains, levees, settling basins, and other improvements as will be necessary, practicable, and feasible in carrying out the purposes of the petition and which will be of public benefit or conducive to the public health, convenience, or welfare. The engineer shall make a full written report to the county auditor setting forth the specifics of his plans. (Heckerling-Florida)
W70-00387

RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
Iowa Code Ann sec 478.28 (1949).

Descriptors: *Iowa, *Railroads, *Mississippi River, *Shores, Legislation, Legal aspects, High water mark, Construction, Maintenance, Cities, Administrative agencies.

When in the construction of a railway it becomes necessary to cross another railway near the shore of the Mississippi River, each shall be so constructed and maintained at the point of crossing that the respective roadbeds thereof shall be above high water mark in such river, but where the crossing occurs within the limits of any city or town containing six thousand or more inhabitants, the council or other government authorities thereof may establish the crossing grade. (Heckerling-Florida)
W70-00388

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
436 SW2d 658-666 (Mo 1969).

Descriptors: *Missouri, *Flood damage, *Overflow, *Damages, Jucidical decisions, Floods, Cloudbursts, Rain water, Runoff, Surface runoff, Obstruction to flow, Natural flow, Artificial watercourses, Drainage, Surface drainage, Legal aspects.
Identifiers: *Apportionment of damages.

During a rainstorm, plaintiff's apartment complex was damaged by flooding allegedly caused by the negligence of a nearby shopping center and by the maintenance of a nuisance by the local municipality. The alleged negligence of the shopping center consisted of allowing a diverted drainage watercourse to become fouled with debris, diminishing the flow of natural drainage from the parking lot. The city was charged with negligently and carelessly maintaining its streets and culverts by permitting weeds and debris to obstruct drainage. In accordance with the lower court's instructions, a general verdict was returned against both defendants jointly. On this appeal, the supreme court reversed and remanded the case for a new trial on the grounds that the city and the shopping center could not be held jointly liable for the entire damage. Quoting extensively from Prosser, the court held that a defendant is liable only for such portion of the total flood damage as may be properly attributed to the negligence of his own acts. (Douberley-Florida)
W70-00389

DRAINAGE DISTRICTS EMBRACING PART OR WHOLE OF CITY OR TOWN.

Iowa Code Ann secs 459.1 to 459.12 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Cities, Legislation, Drainage systems, Drainage programs, Sewers, Cost-benefit analysis, Cost-benefit ratio, Estimated benefits, Public benefits, Cost allocation, Financing, Assessments, Drainage, Local governments, Legal aspects, Administrative agencies.
Identifiers: Counties.

The board of any county has the same power to establish a drainage district that includes whole or part of a city or town as they have to establish a district outside a city. A district may not be established wholly within the city limits or for sewer purposes. When a city is benefitted by district improvements, the commissioners classify and assess the benefits and serve notice on the city clerk and on the owners of the lots, parcels and railway rights of way assessed. Provisions are made for objections to the assessments. The board or the city council has the same power to issue improvement certificates, drainage bonds, or waivers for benefits to public property as conferred with relation to assessment for benefits to highways. Cities may issue bonds to pay assessments. When all of a city is included in a district and makes up over one-fourth of the district, the city may request that the county relinquish authority and control of the drainage district if drains are needed or used for storm sewer and drainage purposes. The city takes complete control and responsibility for maintenance. (Douberley-Florida)
W70-00390

SENECA PORT DISTRICT.

Ill Ann Stat ch 19, secs 352.14, 354.1-354.4, 364 (Smith-Hurd 1963).

Descriptors: *Illinois, *Administrative agencies, *Navigable waters, *Port authorities, Legislation, Regulation, Riparian rights, Docks, Piers, Bulkheads, Jetties, Bridges, Weirs, Shores, Shorelines, Public rights, Navigation, Water management, Public benefits.
Identifiers: *Penalties (Civil).

Navigable waters are any public waters used or usable for water commerce. The Seneca Port District has the power to issue permits for the following: construction of all wharves, piers, dolphins, booms, weirs, breakwaters, bulkheads, jetties, bridges, or structures over, under, in, or within forty feet of any navigable waters within the district, and the depositing of rock, earth, sand, or other material in said waters. The district is responsible for the prevention or removal of obstructions, the location and establishment of dock and shore lines, and the regulation of navigation and bridges. The district regulates the depositing of refuse or other material near navigable waters. Any structure, fill, or deposit erected or made in any of the public waters within the port district in violation of these regulations is a purpresture and may be abated as such at the expense of the person responsible therefore or modified as the district may direct. (Moulder-Florida)
W70-00393

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.

Ind Ann Stat secs 27-1501 thru 27-1508 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Water conservation, *Water districts, *Administrative agencies, Legislation, Water resources, Water resources development, Water utilization, Water treatment, Wildlife conservation, Water supply, Water policy, Soil conservation, Flood control, Drainage, Waste treatments, Waste disposal, Sewage treatment, Sewage disposal, Recreation facilities, Recreation demand, Federal government, Local governments.

To better meet the serious problems of water management in the state, landowners may organize water conservation districts which have the power to levy taxes and other necessary powers so that maximum beneficial utilization can be made of Indiana's water resources. Districts may be established for: (1) flood prevention and control; (2) improving drainage; (3) irrigation; (4) providing water supply; (5) collecting, treating and disposing of sewage and liquid waste; (6) developing forests, wildlife areas, parks, and recreational facilities; and (7) preventing erosion. These purposes may be accomplished by cooperating with state and federal agencies. Districts may only operate within bounds of the purposes for which they were established, but can add additional purposes by following the procedures provided for the establishment of districts. Cities may be included within a district provided that the majority of freeholders thereof have petitioned to be included. Freeholders desiring the establishment of a district must file a petition with the circuit court of the county containing the most land within the proposed district. Area may be added to a district in the same manner. (Marsee-Florida)
W70-00395

PLANS OF RECLAMATION.
SC Code Ann secs 18-471 thru 18-490, 18-501 thru 18-508, 18-521 thru 18-528 (1962).

Descriptors: *South Carolina, *Land reclamation, *Drainage programs, *Administration, Dikes, Dams, Bridges, Buildings, Eminent domain, Costs, Cost allocation, Cost benefit analysis, Legislation, Reclamation, Roads, Road construction, Drainage districts, Appraisals, Damages, Drainage, Land development, Financing, Loans, Taxes, Administrative agencies, Channeling, Construction.

A plan for reclaiming lands from overflow or damage by water shall be adopted by the board of supervisors of the drainage district, based upon a report from the chief engineer. Three court appointed commissioners shall appraise all lands involved and shall assess the amount of benefit and damage that will accrue to each tract of land. If the costs are found to be excessive, the court shall dissolve the district. The board of supervisors of the drainage district is empowered to finance the administration costs by appropriate taxes and loans. The board may build, excavate, construct, and complete all works needed to maintain the plan of reclamation. In order to effect the plan, the board may: (1) alter any watercourse in any manner; (2) construct and maintain ditches, canals, levees, dykes, dams, bridges, roads, or any other works improvement deemed necessary; (3) remove any fence or building; (4) hold, control, condemn, and acquire any land or water; and (5) construct any hydroelectric plants. If any corporation shall refuse to construct or enlarge its bridge, the board shall proceed to let the work at the corporation's expense. (Smith-Florida)
W70-00396

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
Ark Stat Ann secs 20-334, 20-336 (1968).

Descriptors: *Arkansas, *Construction, *Flood control, *Eminent domain, Legislation, Land tenure, Cities, Projects, United States, Contracts, Operation and maintenance, Administrative agencies, Railroads, Right-of-way, Condemnation, Damages, Assessments, Legal aspects, Levees, Land use.
Identifiers: Improvements.

Municipal levee and flood control improvement districts may construct and maintain levees and flood control projects under, over, across, and along the waters and lands belonging to the state, along and over public streets and highways, along and across any railroad right-of-way, and on and over any lands belonging to the municipality. The improvement district may enter contracts with the United States for the construction of such levees or flood control projects. The circuit judge of any county shall appoint appraisers to assess damages when private land for such projects is taken by eminent domain. (Heckerling-Florida)
W70-00398

SOIL AND WATER CONSERVATION COMMISSION.

Ark Stat Ann secs 9-118 thru 9-128 (Supp 1967).

Descriptors: *Arkansas, *Administrative agencies, *Water conservation, *Soil conservation, Local governments, Interstate rivers, Interstate compacts, Drainage systems, Irrigation, Flood protection, Legislation, Water supply, Reservoir storage, Industrial water, State governments, Conservation, Flood control, Federal government, Water control.

The Arkansas Soil and Water Conservation Commission assumes the functions and duties of the now abolished Water Conservation Commission and the Water Compact Commission. The Commission also has all the powers and duties of the Arkansas Geological and Conservation Commission that relate to soil conservation and flood control. Among other powers, the Commission has authority to (1) negotiate with adjoining states concerning the protection and use of interstate waters; (2) cooperate with other states' agencies and federal departments to further water and soil conservation and flood protection; (3) cooperate with local organizations and drainage districts in the development and construction of flood control, drainage, and irrigation projects; and (4) cooperate with counties and municipalities in the development of water supply and storage facilities for consumption and industrial use. (McDonough-Florida)
W70-00404

FLOOD PREVENTION.
Ind Ann Stat secs 48-4901 thru 48-4952 (1963), as amended, (Supp 1968).

Descriptors: *Indiana, *Flood control, *Local governments, *Flooding, Flood plain zoning, Flood protection, Levees, Dikes, Streams, Eminent domain, River training, Obstruction to flow, Barriers, Bridges, Costs, Cost-benefit ratio, Cost allocation, Cost sharing, Alteration of flow, Channelling, Construction, Bridge construction, Legislation.

When any street of any city is subject to flooding by a stream bordering upon or running through such city, and when such flooding may be lessened or prevented by altering or changing such stream, construction or enlargement of dykes or levees, removal of obstructions or encroachments on such stream, or the elevation of any bridge, then such city may petition the circuit court in that county to have such corrective action taken. The court shall determine who shall bear the expenses and may appoint two appraisers to apportion the costs among the parties according to the portion of benefit received. Any dissatisfied party may appeal. Any city may seek to have any proposed bridge construction enjoined if flooding may result from such bridge. Any city may petition the circuit court for the creation of flood control districts. Each flood control board is authorized to perform all acts necessary to carry out the purposes stated in the court's decree. Such board's powers shall include the power of eminent domain. (Smith-Florida)
W70-00405

ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
Ark Stat Ann secs 10-1101, 10-1103, 10-1105, 10-1107, 10-1111 (1958), as amended, (Supp 1967).

Descriptors: *Arkansas, *Flood control, *Land use, *Federal government, Migratory birds, Conservation, National wildlife refuges, Irrigation, Fish hatcheries, Hydroelectric plants, Dams, Legislation, Public lands, Watershed management, Channel improvement, Land development, National forests, Condemnation, Navigable waters, Wildlife management.
Identifiers: Land acquisition.

Arkansas consents to United States' purchase of and cedes its jurisdiction to any site or grounds for the erection of any navy yard, custom house, lighthouse, lock, dam, or fish hatchery. When necessary the United States may acquire Arkansas land by purchase, condemnation, or otherwise for the construction of dams, reservoirs, floodways, canals, hydroelectric power plants, channel improvement and channel diversions for the control of floods, irrigation of lands, and the development of hydroelectric power. The federal government may acquire Arkansas forest lands for national forest purposes in cooperation with the state for the protection of navigable stream watersheds. The federal government may establish fish and game regulations in national forest areas; these rules run concurrently with those of the Arkansas game and fish commission. The United States may acquire such lands and waters as the Secretary of the Interior deems necessary in furtherance of migratory bird acts. (McDonough-Florida)
W70-00406

ORGANIZATION OF DRAINAGE DISTRICTS.

Ill Ann Stat ch 42, secs 1-1 thru 1-7 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Adjudication procedure, *Jurisdiction, Legal aspects, Ditches, Drainage systems, Administration, Drains, Organizations, Legislation, Administrative agencies.

The county circuit courts have jurisdiction over all matters pertaining to the organization and operation of drainage districts. Petition for the organization of a district must be filed with, and all subsequent proceedings had in, the circuit court of the county wherein the greater portion of the land in the proposed district is located. All districts heretofore organized under prior acts, their assessments and proceedings are declared valid. The commissioners of districts organized under prior law must file a report with the appropriate circuit court for the purpose of transferring jurisdiction over and records of such existing districts to the court. For purposes of this act ditch, drain, drainage district, drainage structures, drainage system, landowner, and sanitary purposes are defined. (Marsee-Florida)
W70-00408

4B. Groundwater Management

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02A.
W70-00054

WATER WELL DRILLERS.

Ind Ann Stat secs 42-2001 thru 42-2005 (1965).

Descriptors: *Indiana, *Water wells, *Drilling, *Administrative agencies, Legislation, Drilling equipment, Land tenure, Wells, Conservation, Permits, Water levels, Regulation, Control, Legal aspects.
Identifiers: Penalties (Criminal), Licenses.

A water well drilling contractor, before drilling any water well, must secure a license from the Department of Conservation. The contractor shall keep accurate records for each water well drilled and forward a copy of the record to the Division of Water Resources of the Department of Conservation. This act shall not apply in cases where a well is drilled by the owner of land with his own drilling equipment. The license of any water well drilling contractor may be suspended by the Department for any of the reasons provided herein. Violation of the provisions of this act shall be a misdemeanor with imprisonment and/or fine as punishment. (Heckerling-Florida)
W70-00179

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02F.
W70-00204

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
Northern Illinois Univ., DeKalb. Dept. of Geology.
Loren T. Caldwell.
Water Resources Bull, Vol 5, No 3, p 3-17, Sept 1969. 15 p, 7 fig, 1 tab, 7 ref.

Descriptors: *Water resources, *Surveys, *Groundwater, *Aquifers, *Alluvium, Water resources development, Irrigation water, Water wells, Water yield, Hydrologic data, Data collections, Water quality, Transmissivity, Stratigraphy.
Identifiers: *New South Wales (Australia), Gwydir Valley, Alluvial fans.

Logs of 118 water wells in the western third of the Gwydir River Valley, New South Wales, Australia were studied to determine the location and extent of good aquifers in an alluvial fan. Well depths, aquifer thicknesses, water yields, and well locations are tabulated, mapped, and correlated. The aquifers consist of sand, gravel, and basaltic alluvium in distributary channels. The deepest of 4 identified aquifers is 75-250 ft deep and has a maximum capacity of 180,000 gph from 30 wells. The other 3 aquifers are shallower and have 45 wells with a total maximum yield of 138,000 gph. The surface expressions of the good aquifers may be used for locating irrigation well sites. (Knapp-USGS)
W70-00207

TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
Dienst der Publieke Werken, Amsterdam (Netherlands).
J. Bardet.
De Ingenieur, No 51, p A758-A762, Dec 20, 1968. 7 fig.

Descriptors: *Ground-water recharge, *Settlement, *Power plants, *Cooling water, Groundwater.

If ground-water is pumped up for cooling purposes, considerable risks are encountered when the subsoil layers are compressible. These risks can be minimized in many instances by judiciously planned recharging methods. As a whole, preliminary investigations, recharging-outfit maintenance and controlling measures are rather expensive. If possible, other methods of cooling, etc., would seem preferable. (Rietveld-Vanderbilt)

W70-00302

4C. Effects on Water of Man's Non-Water Activities

DRAINS AND LEVEES AFFECTING HIGHWAYS.
Ind Ann Stat secs 27-407, 27-408 (1960).

Descriptors: *Indiana, *Highways, *Erosion control, *Slope protection, Drainage, Ditches, Stream erosion, Streams, Overflow, Administrative agencies, Costs, Construction, Construction costs, Jurisdiction, Federal jurisdiction, Levees, Embankments, Roadbanks, Bridges, Eminent domain, Maintenance, Watercourses (Legal), Bank protection, Bank erosion, Legislation, Legal aspects, Navigable waters, Right-of-way, Drainage systems.
Identifiers: *Highway protection.

Governing bodies or state agencies charged with the construction, maintenance, and repair of public highways and bridges may protect same from damage by erosion, wash, slides, change of course or overflow by: (1) changing or restoring the course of any watercourse; (2) protecting the banks or slopes of watercourses by necessary construction work; or (3) constructing walls or levees if practicable or less expensive. When any navigable stream is under the jurisdiction of a federal authority or agency and the proposed work conflicts with that jurisdiction, highway officials must obtain the consent of such agency before commencing work. Maintenance and construction costs must be paid out of the appropriate fund of the agency performing the work. The governing or administrative bodies charged with the control of highways may procure rights of way, property, or interests in land outside the limits of any highway by grant, purchase, donation, or eminent domain. Persons wishing to alter drainage systems along highways must first receive approval from the State Highway Commission of Indiana or the board of county commissioners; this provision does not affect the restoration of existing ditches or drainage systems to their original specifications. (Marsee-Florida)
W70-00011

SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Geography.
Robert A. Muller.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 127-136, 1967. 10 p, 4 fig, 5 tab, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Water balance, *Urbanization, New Jersey, Evaporation, Rainfall, Runoff, Hydrologic budget, Infiltration, Water storage, Flood control.
Identifiers: Thornthwaite method, Raritan River basin (NJ).

In order to gain some understanding of hydroclimatological processes and interrelationships associated with urbanization of drainage basin, water balance methodology including the Thornthwaite potential evapotranspiration and water balance models are applied to the Raritan River basin in New Jersey. The precise objectives are to compare and contrast selected Thornwaite water balance components as calculated by several more or less 'standard' techniques, to demonstrate that potential evapotranspiration and water balance models can be utilized as hydroclimatological controls to obtain first approximations of the consequences of land cover type change or urbanization within a river basin, and to explore briefly generated water balance data based on the assumption of the transformation of a watershed from rural to urban. Calculated runoff takes into account the monthly and seasonal variation of precipitation and soil moisture storage as well as energy availability for evapotranspiration loss. Measured runoff not only includes the climatic variation but in addition the effects of land use change. Hence, the differences between calculated and measured runoff over time should be a measure of the effects of land use change on runoff. (Knapp-USGS)
W70-00057

WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.

Colum L Rev, Vol 45, No 5, p 792-795, Sept 1945. 4 p, 23 ref.

Descriptors: *Riparian rights, *Federal government, *Water utilization, *Streamflow, Stream improvement, Navigation, Industries, Damages, Compensation, Judicial decisions, Navigable waters, Non-navigable waters, Easements, Water level fluctuations, Legal aspects, Streams, Hydroelectric plants, United States, Ownership of beds, Water rights.

Power from claimant's hydroelectric plant located on a navigable stream was developed by the fall of water from the artificially raised level of a non-navigable stream entering into the St. Croix, a navigable stream. The level of the St. Croix was raised by the United States to improve navigation, thus causing a loss of power to claimant. The United States Supreme Court held that the economic loss suffered by claimant was not a taking of property for which compensation must be made under the Fifth Amendment. The existence of private property rights in the bed of a navigable stream is determined by the law of the state in which the stream is located. However, these rights are subject to the superior rights, powers, or dominant easements possessed by the federal government. It is well settled that there can be no private property rights in the flow of a navigable stream as against the government. It would seem that if the court had considered the economic loss in the instant case as consequential, the holding would have been more in accord with prior precedents. Moreover, in an analogous situation, the interference with subsurface drainage, the result has also been held consequential. (Heckerling-Florida)
W70-00091

JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
442 SW2d 176-178 (Ct App Mo 1969).

Descriptors: *Missouri, *Obstruction to flow, *Flood damage, *Damages, Crops, Streams, Legal aspects, Judicial decisions, Floodwater, Brush, Usufructuary right, Rain, Floods, Relative rights.

Plaintiff sued defendant for damages to growing crops caused by the flooding of plaintiff's crop land. Defendant deposited logs, brush, and other debris in a creek at a place where it flowed across his land. Several months later, plaintiff's crop land, which was adjacent to and upstream from defendant's property, was inundated by flood waters. The defendant appealed the lower court's decision in favor of plaintiff on the basis of instructions to the jury relating to damages. The lower court's instructions did not distinguish the cause of the damages from defendant's act of obstructing the creek and the damages that would naturally ensue from the heavy flooding. The court held that the instructions to the jury should inform them of the necessity of determining whether the damages alleged were caused by the obstruction or the flooding. Defendant could only be liable for damages proximately resulting from his obstructing the flow of the creek. (Holt-Florida)
W70-00104

GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
253 A2d 867-872 (Md 1969).

Descriptors: *Maryland, *Drainage, *Drainage effects, *Drainage practices, Drainage water, Groundwater, Drainage systems, Land management, Paving, Running waters, Soil conservation, Surface waters, Excess water (Soils), Surface runoff, Mudflows, Soils, Silts, Legal aspects, Judicial decisions, Runoff, Floods, Floodwater.
Identifiers: Civil procedure, Demurrers.

This action arose when the original defendants, now third-party plaintiffs, were not allowed to join certain third-party defendants in a suit which was instituted against them by plaintiff Parklawn Inc, a large commercial cemetery in Montgomery County. Parklawn brought the original action to recover damages resulting from third-party plaintiffs' failure to take precautions necessary to prevent an increased run-off of water, dirt, silt, and debris onto plaintiffs' land. Such damage was allegedly caused when the owners of a shopping center complex next to Parklawn failed to make suitable adjustments to the natural drainage system after altering the natural state of the land in building the shopping center. The Maryland Court of Appeals held that, since Parklawn alleged negligence on the part of the defendants who in turn alleged that third-party defendants were liable to them for contribution, the lack of concert ab initio in the negligence which caused Parklawn's damage did not preclude third-party plaintiffs' joining such third-party defendants. The case was reversed and remanded with direction. (Johnson-Florida)
W70-00176

SEWERS AND DRAINS IN CITIES AND TOWNS.

Ind Ann Stat secs 48-3948 thru 48-3950 (Supp 1968).

Descriptors: *Indiana, *Local governments, *Drains, *Sewers, Administrative agencies, Construction, Benefits, Costs, Cost allocation, Cost-benefit theory, cost-benefit analysis.

Whenever the Board of Public Works orders the construction of any local sewer or drain, it shall adopt a resolution to that effect. A hearing will be held, after which the Board shall decide if the benefits to be derived are worth the estimated cost. (Darragh-Florida)
W70-00190

WATER RIGHTS.
Ind Ann Stat secs 27-1401 thru 27-1409 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Water rights, *Water users, *Water allocation (Policy), Preferences (Water rights), Riparian rights, Administrative agencies, Competing uses, Regulated flow, Relative rights, Domestic water, Impounded waters, Equitable apportionment, Industrial water, Irrigation programs, Low-flow augmentation, Water requirements, Reservoir operation, Distribution patterns, Distribution, Water contracts, Stock water, Surface waters, Groundwater, Watersheds (Basins), Beneficial use, Legislation, Reasonable use.
Identifiers: Public waters.

Surface waters of the state must be put to beneficial uses to the fullest extent possible in the interests of the general welfare. Water in any natural body, stream, or lake is a natural resource and public water. Diffused surface water is not public water. Owners of land contiguous to a public watercourse may impound or use diffused surface water for domestic needs when the flow in the stream or lake level is in excess of existing reasonable uses. Entities creating additional stream volumes by releases from impoundments may use such increased flowage, but riparian owners shall have no rights therein beyond normal stream flow. Upon approval of the Indian Flood Control and Water Resources Commission, persons may divert floodwaters for any useful purposes. The Commission shall mediate disputes between users of surface waters and may require reports on the volume of surface and

groundwater used. The Commission may dispose of and sell certain stored water. Surface water, groundwater, diffused surface water, watercourse, watershed, flood water of a watercourse, and water supply are defined. Standards for measurement of flowing and stored water are established. (Marsee-Florida)
W70-00198

THE WATER RESOURCE,
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 06G.
W70-00272

4D. Watershed Protection

AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
Erhard F. Joeres.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 261-273, 1967. 13 p, 3 fig, 18 ref, 1 appe .d.

Descriptors: *Sediment control, *Optimization, *Dynamic programming, Sedimentation, Erosion, Economics, Costs, Floods, Damages, Computer programs, Model studies, Mathematical models.
Identifiers: *Sediment control optimization.

An economic investigation was made of the problem of drainage basin sediment control, and an analytical system was developed to optimize control measures to best meet the needs of society. Dynamic programming was used in the optimization because the elements of sedimentation costs are relatively independent of each other, and downstream decisions are influenced by actual operations upstream in the drainage basin. A schematic flow chart describes the optimization process, and the mathematical basis of each step is discussed. (Knapp-USGS)
W70-00060

OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.

Am Forests, Vol 61, No 1, p 17, Jan 1955. 1 p.

Descriptors: *Arkansas, *Watershed management, *Surface waters, *Administration, Riparian rights, Appropriation, Condemnation, Regulation, Permits, Beneficial use, Administrative agencies, Recreation demand, Cities, Industrial water, Agricultural watersheds, Conservation, Administrative decisions, Legislation.

Arkansas follows the riparian doctrine. The riparian owner's right is a vested one and probably cannot be taken except by condemnation. Arkansas' water rights bill is intended to accomplish the following results: (1) declare the public policy to be that title and control of surface waters in excess of domestic needs of riparian owners is in the state; (2) create a water permit system favoring early applicants and those making a beneficial use of such water; (3) exempt domestic use from permits; (4) be flexible enough to permit the water commission to determine whether preference in a given watershed should be given to recreation and conservation of wildlife, municipal, industrial, agricultural, or other beneficial purposes; (5) provide for adequate notice to satisfy due process, and once a right conferred, it will have incidents of ownership similar to those in states following the appropriation doctrine, and (6) provide for adequate judicial review of administrative decisions. (Holt-Florida)
W70-00087

WABASH VALLEY COMPACT.
Ind Ann Stat secs 68-906 thru 68-911 (1961).

Descriptors: *Indiana, *Interstate commissions, *Resources, *Conservation, River basin development, Valleys, Optimum development plans, Interstate compacts, Water resources development, Interstate rivers, Water utilization, Planning.

The Wabash Valley Interstate Commission is created to encourage and facilitate coordinated development of the Wabash Valley. 'Wabash Valley' means the Wabash River, its tributaries and all lands drained by said river and tributaries. The Commission shall have the power to : (A) promote the balanced development of the Wabash Valley; (B) recommend integrated plans and programs for the conservation, development, and proper utilization of the water, land, and related natural resources of the valley; and (C) secure the necessary research and development activities. (Smith-Florida)
W70-00193

WATERSHED CONSERVANCY DISTRICTS.
Ky Rev Stat Ann secs 262.700 thru 262.795 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Watershed management, *Watersheds, Erosion control, Flood control, Sediment control, Water conservation, Multiple-purpose projects, Decision making, Programs, Project planning, Water districts, Legislation, Financing, Condemnation, Tax rate, Assessments, Operating costs, Taxes, Soil conservation, Operation and maintenance.

Subdistricts of a soil conservation district may be formed into watershed conservancy districts and shall constitute a government subdivision of the state and a public body corporate. Their purpose shall be to develop and execute programs relating to water conservation, flood and erosion control, and prevention of floodwater and sediment damage. Provisions for the creation of such a district are outlined. A board of directors is to be elected, and provisions are made for membership, terms, officers, and qualification. The powers of the board, including taxation, acquisition of land, borrowing money, and construction and maintenance of needed structures are detailed. Provisions for an annual budget are included, and procedures for assessing and collecting taxes are provided. The processes for annexing or detaching land from the watershed district are described. A detailed procedural process for executing programs developed by the board is included. (Schram-Florida)
W70-00368

JOINT CONSTRUCTION OF WATER SUPPLY.
For primary bibliographic entry see Field 03D.
W70-00371

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
Ind Ann Stat secs 48-5208, 48-5210 thru 48-5219 (1963), as amended, (Supp 1968).

Descriptors: *Indiana, *Lake Michigan, *Erosion control, *Navigable rivers, Docks, Harbors, Navigation, Bank protection, Bank erosion, Erosion, Beaches, Beach erosion, Banks, Lakes, Jetties, Sea walls, River training, Channel improvement, Canals, Navigable waters, Condemnation, Local governments, Basins, Jurisdiction, Legislation, Administrative agencies.

To prevent erosion of the beach, bank, shore or land abutting on Lake Michigan, the board of public works or council of any city or town is empowered to construct proper jetties, groins and seawalls, to cause the shore on the land side of such sea-walls to be filled, and to make improvements as required by law. Any city or town may widen, straighten, or deepen any stream, water-course, canal, navigable stream or lake for harbor, dock, or wharf purposes or to facilitate navigation. Such city may take the necessary land by gift, purchase, or condemnation. In the case of streams or navigable rivers, they shall not condemn a strip more than three hundred feet wide unless necessary to construct a turning basin. Such city or town shall exercise this jurisdiction five miles beyond its corporate limits, except that permission shall be necessary when any other city or town falls within such five mile jurisdiction. Two or more cities may join in such work or in any project to construct a swinging gate or other structure. Where a river and a canal unite, they shall be considered one river. (Smith-Florida)
W70-00392

ARKANSAS FORESTRY COMMISSION.
Ark Stat Ann sec 9-721 (Supp 1967).

Descriptors: *Arkansas, *Administrative agencies, *Flood protection, *Erosion control, Watersheds (Basins), Watersheds (Divides), Recreation, Erosion, Forests, Forest management, Reforestation, Flood control, Legislation, Land use, Watershed management, Legal aspects.
Identifiers: *State forests.

The State Forestry Commission may acquire land in the name of the state which it determines to be valuable for watershed protection, erosion and flood control, forestation, reforestation, and recreation. Such lands shall be parts of state forests. (McDonough-Florida)
W70-00407

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
Michigan Univ., Ann Arbor. School of Public Health.
John J. Gannon, and C. T. Wezernak.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif. p325-338, 1967.
FWPCA Grants WP-15-06 and Grant WP-91-Mich Univ.

Descriptors: *Water quality, *Surface waters, *Surveys, Water analysis, Water pollution effects, Water chemistry, Aqueous solutions, Suspended load, Data collections, Hydrologic data, Hydrographs, Hydrograph analysis.
Identifiers: Water quality surveys.

The methods of designing and executing stream water quality surveys are reviewed and illustrated. Physical measurements, monitoring, water quality measurements, data summary, and interpretation are discussed. A bibliography of 34 references is included. (Knapp-USGS)
W70-00063

INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-00240

SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
Missouri Univ., Kansas City. Dept. of Chemistry.
K. L. Cheng.
Talanta, Vol 14, p 875-877, 1967. 3 p, 6 ref. Work supported by Grad School, Missouri Univ, and OWRR, Dept of Interior.

Descriptors: *Analytical techniques, *Chemical analysis, *Spectrophotometry, *Chromium, Laboratory tests, Colorimetry, Chemistry, Color reactions, Indicators, Test procedures.

Identifiers: Xylenol orange, Methylthymol blue, Complex ions.

A new simple and sensitive method for determining traces of chromium is described. Xylenol Orange and chromium (III) form a red complex at pH 3 on heating in boiling water for 20 min. The molar absorptivity is 19,000. No catalytic action of the bicarbonate ion, carbon dioxide, or chromium (II) generated by metallic zinc was observed. Methylthymol Blue is a less sensitive reagent for chromium, the molar absorptivity being 11,500. (Knapp-USGS)
W70-00260

THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
James H. McDermott, Dwight G. Ballinger, and William T. Sayers.
Analysis Instrumentation, Vol. 6, p 97-104, 1969. 1 tab, 3 fig, 13 ref.

Descriptors: *Instrumentation, Management, Planning, Sanitary engineering, *Surveillance, *Water pollution control.

Public recognition of the fact that our water resources are limited has led to a stepped-up program for preserving and enhancing the quality and value of this natural resource. This is reflected in recent Federal and state legislation and in the size of the national clean-up program. Concomitant to this program is the need for field, laboratory, and aerial instrumentation capable of evaluating and controlling waste sources and the waters receiving these wastes. Automatic instrumentation presently available and that in the future are discussed.
W70-00305

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
Black and Veatch, Kansas City, Mo.
For primary bibliographic entry see Field 05F.
W70-00308

5B. Sources of Pollution

MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
Iowa State Univ., Ames. Dept. of Civil Engineering; and Iowa State Univ., Ames. Engineering Research Inst.
Merwin D. Dougal, and E. Robert Bauman.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 242-253, 1967. 12 p, 4 tab, 13 ref. OWRR Proj No A-001-IA.

Descriptors: *Biochemical oxygen demand, *Mathematical models, *Statistical models, Statistical methods, Oxidation, Oxygen demand, Dissolved oxygen, Water pollution effects, Computer programs, Forecasting.
Identifiers: BOD Models, Monomolecular BOD models.

The development and application of the widely-used monomolecular model for biochemical oxygen demand BOD is reviewed. Results of laboratory BOD studies are used to reveal that the monomolecular model fails to satisfy its fundamental assumptions. Temporal variations in the rate constant and the ultimate BOD value are explored for three types of wastes: (a) raw domestic sewage, (b) final effluents from various waste treatment processes, and (c) contents of an agricultural waste lagoon. Two different mathematical models for BOD are presented which statistically are superior to the monomolecular model. These models may be useful in future studies of stream water quality and in the determination of stream assimilative capacities. (Knapp-USGS)
W70-00059

THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
Kansas Univ.,Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-00062

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
For primary bibliographic entry see Field 05G.
W70-00167

INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
Geological Survey, Washington, D.C.
P. H. Carrigan, Jr.
Geol Surv Prof Pap 433-I, 1969. 18 p, 14 fig, 5 tab, 20 ref.

Descriptors: *Path of pollutants, *Radioactive wastes, *Tennessee, Radioisotopes, Sediments, Alluvium, Radiochemical analysis, Water pollution sources, Water pollution effects, Sampling, Surveys.
Identifiers: Oak Ridge, Clinch River (Tenn).

An inventory has been made of the radionuclides associated with bottom sediment in the lower Clinch River. The reach included in this inventory extends 21 miles from the mouth of the river to the mouth of Whiteoak Creek. The source of the radionuclides in the sediments was the release of low-level-radioactive waste waters from the Oak Ridge National Laboratory into Whiteoak Creek basin and thence into the river via Whiteoak Lake. Results of the inventory indicate that the following quantities of radioactivity were associated with the bottom sediment in July 1962: 150 curies of cesium-137; 18 curies of cobalt-60; 16 curies of ruthenium-106; at least 10 curies of rare earths; and 2.9 curies of strontium-90. Most of the radioactivity was found to be downstream from mile 15; about 95% of the identified radioactivity was in this reach. Maximum concentration of radioactivity occurred near the mouth of Whiteoak Creek. A high proportion of cesium-137 (21%), rare earths (about 25%), and cobalt-60 (9%) released to the river are retained in bottom sediment of the study reach. Retention of ruthenium-106 and strontium-90 is minor--less than 1% each. (knapp-USGS)
W70-00240

LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
Department of Water and Sewers, Chicago, Ill.
Hyman H. Gerstein.
J American Water Works Association, Vol 57, p 841-857, July 1965. 7 fig, 7 tab.

Descriptors: *Lake Michigan, *Water supply, Intakes, Nutrients, Quality control, Treatment facilities, Filtration, Sewage, Coliforms, Eutrophication, Odor, Ammonium compounds, Activated carbon, Chlorine, Phenols, Oil wastes, Hydrogen ion concentration, Fluorides, Alkyl benzene sulfonates, Wind velocity, Taste, Coagulation, Plankton, Monitoring, Temperature, Detergents, Phosphorus compounds, Diatoms, Biochemical oxygen demand, Dissolved oxygen, Color, Dissolved solids, Biodegradation, Algae, Iron, Sulfates.
Identifiers: *Pollution, *Chicago (Ill), Cook County (Ill), Calumet River (Ill), Pools, Wind direction, Tabellaria, Fragilaria, Asterionella, Filter clogging, Stephanodiscus hantzschii, Stephanodiscus binderanus, Cladocera, Water masses, U S Public Health Service, Great Lakes-Illinois River Basins Project, Indiana Harbor Ship Canal.

Although no sewage and industrial wastes are discharged along 30 miles of Chicago's lake front, gross pollution exists in the southern end of Lake Michigan. Data over 40 years reveal quality at the intakes, and, from 1950 to 1964, illustrate pollutional trends. A general increase of eutrophication indicators and increase in number and intensity of periods when pollutants seriously affected the intake at the South plant appear in the last ten years. Slugs of wastes may have abnormal odors, like those of oil refinery wastes diluted with lake water. Since 1948, samples have been collected one day each week at established points. Pollutional pools, influenced by wind-induced lake currents, were observable in a series of taste and odor incidents. The principal agent in treatment for removal of taste and odor is activated carbon. In treating highly polluted waters, application of chlorine sufficient to decompose ammonia-nitrogen may not adequately destroy the bacteria, whereupon bacteriologically unsafe water may result. Increasing plankton growth necessitates more frequent washing of filters; increased growth of filamentous algae together with appearance of new species of diatoms have caused additional problems with filters. Author presents, as practical and desirable, a series of criteria for quality of Chicago's water supply. (Jones-Wisconsin)
W70-00263

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana State Univ., Baton Rouge.
Daniel H. Stern, and Michele S. Stern.
Louisiana Water Resources Research Inst Tech TR-4, Sep 1969. 60 p, 2 fig, 47 tab, 33 ref. OWRR Proj A-019-LA.

Descriptors: *Limnology, Sline lakes, Storm runoff, *Chemical properties, Physical properties, *Ammonia, Nitrification, Nitrates, Nitrites, Dissolved oxygen, Turbidity, Phosphates, Nutrients, *Coliforms, *Phytoplankton, Water sports.
Identifiers: *Lake Pontchartrain (La).

Sampling from Lake Pontchartrain between November 1968 and July 1969 shows that storm water from canals in Orleans and Jefferson Parishes degrades the water quality and disturbs the biorhythm of the aquatic microbiota. Especially after heavy rains, the increase in coliforms renders nearshore water and certain beaches unsafe for primary water sports. Phytoplankton, whose growth increases owing to nutrients in the storm runoff, add to the bottom organic materials when they die because the light available for photosynthesis has been reduced by turbidity. Bottom organic sediments stirred up by wave action during storms not only cause the turbidity but also furnish food for new planktonic growth. Thus the filling of the lake is hastened. The relationship between the total and fecal coliforms was not consistent. Recommendations include: counting of fecal coliforms to obtain a truer indication of pollution; prohibition of primary water sports at certain beaches after summer rains; careful regulation of proposed storm-water chlorination owing to the presence of ammonia, which retards disinfection and because of possible unreacted chlorine, which will disrupt the natural food cycle; and basin-wide cooperation to halt further pollution. (Hill-Louisiana State Univ)
W70-00309

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
William Whipple, Jr.
Water Resources Research Institute, Rutgers University. OWRR Proj B-002-NJ. Oct 1969. 94 p.

Descriptors: *Biochemical oxygen demand, *BOD, *Organic matter, *Water quality, *Organic loading, Oxygen demand, Dissolved oxygen, Oxygen, Oxygen sag, Water pollution, Effluents.
Identifiers: *BOD mass balance, Unknown organic loading, Unrecorded organic loading, Recorded organic loading, Background organic loading.

A preliminary accounting for organic loading of three New Jersey river basins was undertaken, with the intention of finding a measure of gross man-made pollution. The method used is called a BOD

mass balance analysis, being essentially a reconciliation between organic loadings in the streams, as revealed by water quality records, and the proportion of the loadings accountable for by recorded effluents from waste treatment plants. The most important finding is that on none of the three rivers did the recorded effluents account for as much as half of the total pollution in the stream. After subtraction of estimates of probable background loading, the remaining unknown but presumably man made wastes were very large. The implications from the viewpoint of water quality control are serious. (Whipple-Rutgers)
W70-00314

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
For primary bibliographic entry see Field 05G.
W70-00397

5C. Effects of Pollution

RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
William D. Silvey, and George A. Irwin.
Geol Surv Open-file Rep, Mar 20, 1969. 12 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Fishkill, *Striped bass, *Water pollution effects, *California solutes, Dissolved oxygen, Hydrogen sulfide, Toxicity, Morbidity, Industrial wastes, Solutes, Copper.
Identifiers: *Carquinez Strait (Calif).

No direct quantitative relations were found to indicate the cause of striped-bass mortalities in the Carquinez Strait area, California. Several possible causes of the mortalities were considered but could not be proven. Industrial effluents were considered as a possible cause of mortalities, but evidence was not found to show this possibility. Heavy metals (zinc, lead, and chromium) were analyzed but not found in large concentrations. Copper was found throughout the entire estuary in concentrations of about 0.10 mg/1. If copper was the responsible agent, the mortalities would have been widespread throughout the estuary, but they were not. Mortalities did not occur as a result of spawning. The lack of osmoregulatory adaptation to the sharp salinity gradient in Carquinez Strait is not a major cause of the mortalities. One major probable cause of the mortalities was natural hydrogen sulfide production. Large concentrations of biologically produced hydrogen sulfide were found on and in mudflats in Carquinez Strait at the time of the mortalities peak. Although this alone does not prove a direct cause and effect relation, biologically produced hydrogen sulfide, a natural phenomenon, is the most likely cause of striped-bass mortalities in Carquinez Strait. (Knapp-USGS)
W70-00005

THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 314-324, 1967. 11p, 2 fig, 2 tab, 28 ref.

Descriptors: *Farm wastes, *Confinement pens, *Water pollution sources, Waste disposal, Runoff, Water quality, Oxygen demand, Nutrients, Waste disposal.
Identifiers: Animal production industry wastes.

Until recently animal wastes have been considered as part of the natural or background pollution of a region, and uncontrollable. Animal production is changing from small farm operations into large scale industrial enterprises. There is an increasing trend to confine animals within small areas to produce the greatest weight gain in the shortest period of time. Under such conditions, it is not possible for these animals to drop their wastes on pastures where the wastes can be adsorbed by nature without adversely affecting environment. Animal wastes have been shown to be a major source of surface water pollution and have been implicated in several cases of ground water pollution. Some cases of pollution that have been caused by animal wastes and animal production operations are discussed and the trend toward confinement feeding operations and the magnitude of the problem are outlined. The need to consider animal wastes when developing or protecting water resources is demonstrated. On a volume basis, the total animal waste production in the United States exceeds that by the human population by an order of magnitude. (Knapp-USGS)
W70-00062

COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
Tallinn Polytechnic Inst. (USSR).
A. M. Aitsam, H. A. Velner, and L. L. Paal.
Sbornik statei po sanitarnoi technike IV, Trudy talinskogo politekhnitcheskogo instituta, seriya A, No 247, p 57-65, 1967.

Descriptors: *Mathematical models, *Turbulence, *Diffusion, *Mass transfer, Water pollution, Self-purification, Water quality, Stream pollution.
Identifiers: Turbulent mixing coefficient.

The basic equation of turbulent mass transfer of nonconservative pollutants was solved by Laplace transformation. The analytical solution obtained was complex, but was simplified and the approach to computation of it evaluated and shown practically. The values of the longitudinal mixing coefficient ascertained in some Estonian streams ranged from 0.1 to 1.0 msq/sec., and the decay coefficient of BOD decomposition rate lay within the interval from 0.1 to 1.0 1/day. The formula which was valid in the first step only for constant flow rate (Q= const.) including the linear dependence of discharge on distance, was used on the case of gradually increased flow rate. (Novotny-Vanderbilt)
W70-00146

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN),
Tallinn Polytechnic Inst. (USSR).
L. L. Paal.
Sbornik statei po sanitarnoi technike IV, Trudy talinskogo politechnitcheskogo instituta, seriya A, No 247, p 75-89, 1967.

Descriptors: *Mathematical models, *Turbulence, *Mass transfer, Water pollution, Water quality, Stream pollution.

Solution of concentration wave at triangular, trapezoidal, exponential, and periodical waste load figure is based on the one-dimensional equation of longitudinal turbulent mixing of nonconservative matter. This equation containing the time derivative was solved by the Laplace transformation method respecting boundary conditions. (Novotny-Vanderbilt)
W70-00147

THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
Tllinn Polytechnic Inst. (USSR).
A. M. Aitsam, H. A. Velner, and L. L. Paal.
Materialy po voprosam samoochishcheniya vodoyomov i smeshcheniya stochnikh vod, Tall Pol Inst, p 87-108, June 7-10, 1965. 9 ref.

Descriptors: *Self-purification, *Oxygen sag, Waste assimilative capacity, Water pollution effects, Water quality, Stream pollution, Mathematical models, Environmental engineering.

Analytical solution of mass balance of either nonconservative or conservative pollutants in streams is presented. This solution is applied on BOD, DO, and conservative pollutants concentration changes, and was recommended for the water quality computation of small streams in Estonian SSR. The values of k (1), according to the kind of waste waters discharged into these streams, are tabulated and in the same way the values of Fair's factor f are computed. The solution takes into account the gradually increased flow rate and an additional BOD load. Practical examples and comparison with measured data of a small river basin are given. (Novotny-Vanderbilt)
W70-00148

COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
Tallinn Polytechnic Inst. (USSR).
A. M. Aitsam, H. A. Velner, and L. L. Paal.
Sbornik statei po sanitarnoi technike I, Trudy talinskogo politekhnitcheskogo instituta, seriya A, No 212, p 103-129, 1964. 25 p, 9 fig.

Descriptors: *Waste assimilative capacity, *Oxygen sag, *Self purification, Water quality, Stream pollution.

The Streeter-Phelps formula for dissolved oxygen computation in small streams is criticized and a new differential equation of oxygen balance taking into account the dilution rate of waste in stream is proposed. On this basis it was stated that the Streeter-Phelps formula was valid only if waste waters discharged into rapidly flowing waters. The most critical point from the standpoint of the dissolved oxygen content is the reach of steam just below the waste effluent discharge. The field observation of some small streams in Estonian S.S.R. were used as a proof of validity of the proposed mathematical model. (Novotny-Vanderbilt)
W70-00149

THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
Central Electricity Generating Board, Portishead (England). Research and Development Dept.
C. M. De Turville, and R. T. Jarman.
Int Journal Air and Water Pollution, Vol 9, p 239-251, 1965. 9 fig, 1 tab, 9 ref.

Descriptors: *Diffusion, Thermal power plant, Estuary, Thermal pollution, Cooling water, Mixing, Waste dilution.
Identifiers: Thermal water flumes, Diffusion coefficient, River temperature, Bridge-amplifier circuit, Ebb tide, Turbulent diffusion, Lateral diffusion, River Usk.

The temperature and flow of water in the River Usk estuary adjacent to the two power stations were measured during the hours around low water in a series of boat surveys. Analysis of the measurements made on the ebb tide showed that (a) the current was constant from 120 min before low water until the flow reversal occurred, (b) the flow reversal took 20 min on a spring tide (47 ft, 14 m) and was longer on a neap tide, (c) the warm water was bounded on each side with cool water and mixed laterally with it, and (d) the lateral diffusion coefficient was approximately 20000 cm sq./sec, which is similar to that found in oceans, if the scale length is taken to be the effective width of the estuary. (Ross-Vanderbilt)
W70-00150

EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
Water Pollution Research Lab., Stevanage (England).
A. L. H. Gameson, H. Hall, and W. S. Preddy.
Combustion, Vol 32, No 7, p 37-45, Jan 1961. 7 fig, 9 ref.

Descriptors: *Estuaries, *Heat transfer, Thermal pollution, Discharge (Water), Tidal effects, Mixing.
Identifiers: *Heated discharges, Thames Estuary, Tidal mixing, Temperature distribution.

This paper discusses rate of exchange of heat, derives equations for heat transfer and considers application of the methods used. Heat entering the estuary is dispersed by tidal mixing and displaced toward the sea by the flow of land water. The movement of the water and the mechanism by which the excess heat is lost is explained. Diagrams are given showing the distribution of water after periods of one, two, and three tides using various representations of symmetric mixing. The effects of radiation, evaporation, conduction, and convection on heat exchange are discussed. The four processes which occur in the estuary during the dispersion and cooling of a heated effluent are also discussed. (Ross-Vanderbilt)
W70-00158

CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
Tokugawa Inst. for Biological Research, Tokyo (Japan).
H. Tamiya, T. Iwamura, K. Shibata, E. Hase, and T. Nihei.
Biochimica et Biophysica ACTA, Vol 12, p 23-40, 1953. 13 fig, 3 tab, 6 ref.

Descriptors: *Chlorella, *Correlation analysis, *Photosynthesis, *Metabolism, Light intensity, Chlorophyll, Spores, Aerobic conditions, Temperature, Volume, Phosphorus, Nitrogen, Nutrients, Carbon dioxide, Respiration, Inorganic compounds, Oxygen, Anaerobic conditions, Growth rates, Life cycles, Growth stages.
Identifiers: *Growth, *Chlorella ellipsoidea, 'Dark cells', 'Light cells', Transformation, Interconversion, Nascent dark cells, Active dark cells, Autospores.

In culture, Chlorella cells assume two distinct forms, 'dark cells', smaller in size, richer in chlorophyll content and stronger in photosynthetic activity than the other, the 'light cells'. When illuminated, dark cells grow, with a substantial increase in mass, and turn into light cells; the latter, when ripened, bear autospores which are eventually set free, becoming individual dark cells. Transformation of light cells into dark cells involves no increase of cell mass and occurs only under aerobic conditions, either in light or dark. Dark cells freshly born from light cells are smaller in size and contain less chlorophyll than 'active' dark cells, into which the former turn rapidly under influence of light. In transformation of dark cells into light cells the main thrust is photosynthesis. Transformation of light cells into dark cells involves a light-independent and aerobically endergonic anabolic metabolism, although the transformation, in light, is accompanied by some photosynthetic processes. Authors found that, under weak light, the rate of growth is exclusively determined by photosynthetic processes, whereas light-independent metabolic processes become more or less significant in determining over-all growth rate in strong light. Formulae are constructed describing the processes. (Jones-Wisconsin)
W70-00261

LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
Department of Water and Sewers, Chicago, Ill.
For primary bibliographic entry see Field 05B.
W70-00263

DEATH OF A LAKE,
David C. Flaherty.
Quest, Vol 6, No 4, p 7-15, 1968. 9 fig.

Descriptors: *Lakes, *Algae, *Eutrophication, Oligotrophy, Nutrients, Water temperature, Dissolved oxygen, Fishkills, Limnology, Algal toxins, Algal control, Trace elements, Washington, Nuclear powerplants, Water pollution effects, Phosphorus, Nitrogen.
Identifiers: *Cultural eutrophy, *Nutrient balance, *Lake aging, Nutrient sources, Water sampling, Algal growth, Oxygen depletion, Nuclear activation techniques, Rock Lake (Wash), Williams Lake (Wash), Channeled Scablands (Wash), Washington State University.

Algae are the primary producers which initiate the food chain in lakes leading up to fish and man. In normal lakes, a rough balance exists between incoming nutrients, algal numbers, and their predators. However, this balance is upset by man's influence, hastening change from oligotrophic to eutrophic conditions. Detrimental effects of large numbers of undesirable algal forms, include oxygen depletion resulting in fishkills; flavor, odor, and color in water supplies; induced corrosion and slime in industrial water supplies; and endangering of other aquatic and terrestrial life forms from toxic substances. Studies conducted by Dr. William Funk, Washington State University Civil Engineering professor, on Rock and Williams Lakes in the Scablands basalts of eastern Washington are described. The basalts are relatively low in nitrogen and phosphorus, and decompose slowly, with consequent low natural nutrient income. However, these lakes are endangered by human activities. Present studies measure dissolved oxygen, temperature, light penetration, algal species, and concentrations of various elements including phosphorus and nitrogen. Nuclear activation techniques are used to detect trace elements which Dr. Funk suspects may have a critical role in algal growth. (Ketelle-Wisconsin)
W70-00264

PRIMARY PRODUCTION IN LABORATORY STREAMS,
Oregon State Univ., Corvallis. Dept. of Fish and Game Management; Oregon State Univ., Corvallis. Dept. of Botany; and Oregon State Univ., Corvallis. Pacific Cooperative Water Pollution and Fisheries Research Labs.
C. David McIntire, Robert L. Garrison, Harry K. Phinney, and Charles E. Warren.
Limnology and Oceanography, Vol 9, No 1, p 92-102, Jan 1964. 5 fig, 3 tab, 20 ref.

Descriptors: *Primary productivity, *Streams, *Laboratory tests, Respiration, Environment, Photosynthesis, Oxygen, Trophic level, Light intensity, Ecology, Lotic environment, Biomass, Flow rates, Depth, Dissolved oxygen, Algae, Velocity, Water quality, Dissolved solids, Hydrogen ion concentration, Temperature, Nitrogen, Nutrients, Organic matter, Pigments, Chlorophyll, Diffusion, Cyanophyta.
Identifiers: Community, Specific conductance, Species, Melosira varians, Synedra ulna, Oedogonium, Phormidium retzii, Surface diffusion rate.

Six laboratory streams were used to study primary production and community respiration in simple communities under different environmental conditions. A photosynthesis-respiration chamber was developed which can be used to relate primary production to various environmental conditions and to verify direct measurement of primary production in laboratory or natural streams. Gross primary production in laboratory streams under 6000 lux of illumination ranged from 2.4 to 4.7 grams oxygen/square meter/day. Community respiration ranged from 1.6 to 4.2 grams oxygen/square meter/day. Ratios of photosynthesis to respiration usually varied between 1.0 and 2.0. Illumination intensity was approximately linearly related to primary production in range, 0-4000 lux, maximum photosynthetic rates obtaining at about 21,000 lux. Communities developing on the substrate were seeded naturally by species entering streams through the water supply. Composition of plant communities remained surprisingly constant, usually varying only in relative abundance of different species. The diatoms, Melosira varians and Synedra ulna consistently dominated; Oedogonium spp were sometimes very abundant during summer. Genera of blue-green algae were ubiquitous, frequently growing attached to sides of troughs, near the air-water interface. (Jones-Wisconsin)
W70-00265

SOME ASPECTS OF THE EUTROPHICATION OF WATER,
Water Pollution Research Lab., Stevenage (England).
Morlais Owens, and Gavin Wood.
Water Research, Vol 2, p 151-159, 1968. 3 fig, 2 tab, 17 ref.

Descriptors: *Eutrophication, *Nutrients, Cyanophyta, Fishkill, Reservoirs, Surface drainage, Fertilizers, Detergents, Sewage effluents, Industrial wastes, Lake Erie, Water pollution sources, Water pollution effects, Phosphorus compounds, Nitrogen compounds, Subsurface drainage.
Identifiers: *Great Britain, Nutrient removal, Nutrient concentrations, Nutrient sources, Algal blooms, Oxygen depletion, Flowing water, Eutrophication evaluation, Algal nutrient requirements, Surface-active materials, Lake Washington (Wash), Zurichsee (Switz), Potomac River (D C), Great Ouse (England), Lee River (England), Thames River (England), Oscillatoria rubescens, Anabaena flos-aquae, Water Pollution Research Laboratory (England).

Authors describe symptoms of eutrophication and evaluate the extent of enrichment and associated technical and economic problems. Increasing applications of fertilizers to land and greater use of detergents are partially responsible for higher concentrations of nitrogen and phosphorus in rivers of Great Britain. In the last ten years, amounts of nitrogenous fertilizers applied to agricultural land in Britain have doubled with consequent greater contributions of inorganic nitrogen to rivers from land drainage. Authors suggest, from indirect evidence, that approximately 50% of phosphorus in sewage effluents is derived from detergents. A nutrient balance sheet for a portion of the Great Ouse was constructed to determine the contribution of sewage effluents to the supply of major nutrients in the river. It indicated that while sewage effluents add only a small proportion of the total nitrogen, silicon, chloride, and sulphate, they are responsible for most of the phosphorus. Because of increased demands on water supplies, information on proportions of nutrients derived from various sources is important to base decisions on economically sound remedial action, e. g. establishment of treatment works for nutrient removal. (Ketelle-Wisconsin)
W70-00266

CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
State Zoological Inst. and Museum, Hamburg (West Germany). Hydrobiological Station.
Hubert Caspers.
International Association of Theoretical and Applied Limnology, Proceedings, Vol 15, p 631-638, Feb 1964. 2 fig, 2 tab, 13 ref.

Descriptors: *Lakes, *Eutrophication, *Canals, *Cities, Biological communities, Sewage, Detritus, Tubificids, Plankton, Diatoms, Cyanophyta, Phytoplankton, Rotifers, Chlorophyta, Copepods, Cycles, Chlamydomonas, Algae, Zooplankton, Fish, Chrysophyta, Seston, Self-purification.
Identifiers: *Hypertrophic waters, Hamburg (Germany), Chironomids, Cladocera, Aphanizomenon flos-aquae, Stephanodiscus hantzschii, Didinium, Paramecium, Phacus, Glenodinium, Cryptomonas,

Ciliata, Asterionella formosa, Recolonization, Alster Lake (Germany), Germany.

Alster Lake in Hamburg, Germany, is an example of a typical urban lake and demonstrates the special conditions in city waters, which are specialized habitats and where hydrobiological status can be more readily analyzed than complex sites of 'healthier' waters. Urban waters may constitute a restricted facies of eutropic water where destruction of original communities is typical and no new equilibrium develops. Rather, the relationship between buildup and breakdown of nutritive material, between producers and consumers, is always in a state of temporary equilibrium, and is constantly in danger of becoming unbalanced. The original community loses its most important zone of regeneration, the submerged plants along banks; bottom fauna is burdened with anaerobic processes resulting from inflow of detritus, leaving only a few species whose mass development is inhibited. The surviving plankton tends to instability and extreme variations from year to year. Nevertheless, there are certain definite and regular events which make urbanized waters a unique experimental situation, since the restricted facies of eutrophic water affords us limnological insight into forced production processes and their ecological effects. Author believes that conditions in urban waters improve when plants recolonize the banks. (Jones-Wisconsin)
W70-00268

CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson.
International Association of Theoretical and Applied Limnology, Proceedings, Vol 14, p 167-175, July 1961. 5 fig, 1 tab, 12 ref.

Descriptors: *Nutrients, *Productivity, Nuisance algae, Sewage effluents, Phosphorus, Eutrophication, Washington, Lakes, Water pollution effects.
Identifiers: *Lake Washington (Wash), *Lake changes, *Nutrient concentration, *Nutrient budget, Potential nutrient concentration, Areal income (Nutrients), Lake volume, Mean depth, Dilution, Oscillatoria rubescens, Madison lakes (Wis), Cedar River (Wash), Zurichsee (Switz), Turlersee (Switz), Greifensee (Switz), Paffikersee (Switz), Aegerisee (Switz), Fureso (Switz).

A dense bloom of Oscillatoria rubescens in 1955 prompted a study of Lake Washington to determine effects of a growing human population on lake eutrophication. One phase was an engineering survey made to establish the magnitude of sewage effluent and other sources of nutrients. Increases in nutrients from 1950-1955 were small compared with limnological changes. In order to compare the nutrient status of various lakes, a simple numerical basis of comparison of nutrient rate supply from outside sources is desirable. Systems which incorporate a consideration of the potential concentration of nutrients in lakes are preferable to those relating only income to area. Potential concentration can be related to the areal income and the mean depth of the lake as follows: areal income/mean depth=potential concentration (grams/square meter/meter=grams/cubic meter). The present work deals with only a portion of the problem--comparison of income of phosphorus among lakes. The author presents computations for several lakes in Wisconsin and Europe in addition to Lake Washington, also shows graphs of areal income plotted against potential concentration. Results of such calculations indicate that potential concentration is more closely related to algal standing crop than is the areal income. (Ketelle-Wisconsin)
W70-00270

THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
Bristol Univ. (England). Dept. of Botany.
F. E. Round.
New Phytologist, Vol 60, p 43-59, 1961. 12 fig, 2 tab, 14 ref.

Descriptors: *Cores, *Diatoms, Sediments, Eutrophication, Plankton, Muds, Lake mud, Bioindicators.
Identifiers: *Esthwaite Water (England), English Lake District, Asterionella, Melosira,Cyclotella, Tabellaria.

The diatom flora of a core taken from the center of Esthwaite Water has been analyzed qualitatively and quantitatively. Five periods of deposition have been characterized by indicator species and variations in diatom productivity. The most recent brown lake muds (0-150 centimeters) contain Asterionella, Melosira, Cyclotella, and Tabellaria. Comparison with the present-day diatom flora suggests that a transition to eutrophic conditions, detected in late Post-glacial time, is still occurring. The main diatom zones show good association with the zoning derived from pollen analysis. (Bortleson-Wisconsin)
W70-00271

ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
National Research Council of Canada, Ottawa (Ontario).
P. R. Gorham, J. McLachlan, U. T. Hammer, and W. K. Kim.
International Association of Theoretical and Applied Limnology, Proceedings, Vol 15, p 796-804, February 1964. 1 fig, 3 tab, 22 ref.

Descriptors: *Algae, *Toxicity, *Cultures, *Isolation, Limnology, Public health, Physicochemical properties, Genetics, Bacteria, Peptides, Environmental effects, Heterogeneity, Iron, Manganese, Waterfowl, Cyanophyta.
Identifiers: *Anabaena flos-aquae, *Strains, Phycologists, Veterinarians, Microcystis aeruginosa, Endotoxin, Fast-death factor, Dosage, Species susceptibility, Anabaena Lemmermannii, Ottawa (Ontario), Burton Lake (Saskatchewan), Humboldt (Saskatchewan), Mice, Morphological characters, Tris.

Toxic waterblooms of planktonic blue-green algae have puzzled phycologists, limnologists, veterinarians, and public health officials for more than 80 years. The authors of this paper succeeded in isolating toxic and non-toxic strains of Anabaena flos-aquae from a toxic bloom in Burton Lake, Saskatchewan. Of fourteen strains isolated in 1960 and 1961, eight were toxic and six non-toxic. They showed, for the first time (although long suspected), that this alga can be poisonous. The fast-death factor produced is often secreted into the surrounding water. This and other properties of Anabaena very fast-death factor indicate that it is different from Microcystis fast-death factor. One sample collected in 1960 contained a very fast-death factor, killing mice in one to two minutes after intraperitoneal injection with a minimal lethal dose. Death was preceded by symptoms of paralysis, tremors, and mild convulsions. The salt concentrations giving best growth of one strain of Anabaena flos-aquae in unialgal culture bear little resemblance to those of the lake water from which it was isolated. Interesting changes in growth habit (gradual loss of colonial habit and filament coiling) were observed in culturing Anabaena flos-aquae, illustrating how variable some morphological characters can be. (Jones-Wisconsin)
W70-00273

CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
J. Hrbacek.
International Association of Theoretical and Applied Limnology, Proceedings, Vol 15, p 837-846, Feb 1964. 8 fig, 2 tab, 6 ref.

Descriptors: *Algae, *Cyanophyta, *Ecology, *Eutrophication, Ponds, Reservoirs, Backwater, Fertilization, Nitrogen compounds, Phosphorus compound, Perches, Fish, Diatoms, Carp, Plankton, Metabolism, Biological communities, Daphnia, Nannoplankton, Nutrients, Depth, Domestic animals, Sampling, Nuisance algae.
Identifiers: *Aphanizomenon flos aquae, *Microcystis aeruginosa, Bohemia, Elbe River, Celakovice (Czechoslovakia), Blatna (Czechoslovakia), Cyprinid fishes, Clorococcales, Daphnia pulicaris, Daphnia cucullata, Daphnia hyalina, Daphnia magna, Czechoslovakia.

Knowledge of individual factors which either promote or inhibit water-bloom-forming cyanophytes (blue-green algae), Aphanizomenon flos aquae, and Microcystis aeruginosa is not extensive. This report is based on a comparative study of water-bodies in Bohemia. Ten backwaters in the inundation area of the Elbe River, six fish ponds, and three water reservoirs were sampled at monthly intervals from April to September. In order to examine the relative importance of nitrogen and phosphorus compounds from each of the three categories of water-bodies, the following were selected: one with water bloom consisting of Aphanizomenon with occasionally some Microcystis; one without water bloom, and, insofar as possible, one with Microcystis water bloom. In ponds, backwaters, and reservoirs with and without water blooms, no important differences in content of phosphorus and nitrogen compounds were found. In one bloom-containing reservoir, water showed significantly smaller concentrations of phosphorus compounds than in ponds. An association exists between cyanophytes and Daphnia. Depth had increasing effect on development of water bloom of these two cyanophytes. In ponds, increased fish stock accompanied decreased Aphanizomenon blooms, while in some waterbodies, larger fishstock was associated with development of Microcystis aeruginosa bloom. (Jones-Wisconsin)
W70-00274

PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
Wisconsin Univ., Madison. Dept. of Botany.
Seward E. Allen, and Folke Skoog.
Plant Physiology, Vol 26, p 611-624, 1951. 4 fig, 1 tab, 11 ref.

Descriptors: *Phytotoxicity, Agricultural chemicals, Herbicides, Weed control.
Identifiers: *Imidazoline derivatives, 1-isopropyl-4, 4-dimethyl-2-imidazolines.

Certain 1-isopropyl-4,4-dimethyl-2-imidazolines and other structurally related compounds were found to be toxic to seedlings and larger plants. Their toxic action apparently depends upon a ring nucleus containing carbon and nitrogen linked by double bonds, the lack of any polar substituents in the 4-position, and the length of an alkyl group in the 2-position; and may be due in part to their lipophilic properties. In the greenhouse, corn, wheat, and lambsquarter were fairly resistant; soybeans, table beets, peas, and red-root pigweed were moderately sensitive; and wild mustard, and tomatoes were readily killed by applications of a 0.50% spray. Because they are inactivated by contact with soil, these toxic imidazoline derivatives might be useful as pre-emergence herbicides. (Nichols-Wisconsin)
W70-00275

THE BIOGEOCHEMISTRY OF NITROGEN,
California Univ., Davis. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02K.
W70-00278

THE NITROGEN CYCLE IN THE SEA,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W70-00279

INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
V. Sladecek, and L. Fiala.
Verh Internat Verein Limnol, XIV, p 619-624, Stuttgart, July 1961.

Descriptors: *Reservoirs, *Stratification, *Limnology, Hydroelectric power, Peak power, Plankton, Phytoplankton, Zooplankton, Epilimnion, Hypolimnion, Thermocline.

The influence of peaking power plant in east Bohemia caused a second transition zone in the Pastviuy reservoir during summer. Therefore, the hypolimnion was divided into two parts. The water from the upper part of the hypolimnion went to the turbines, while the water from the lower part of the hypolimnion was stagnant and mostly anaerobic. The epilimnion and part of the metalimnion were not influenced by peak operating conditions, and thus, biological observations showed that plankton in the reservoir were unaffected. The temperature, D.O. content, and number of plankton in the flow control basin were very low, which was caused by the water discharged from the hypolimnion. (Novotny-Vanderbilt)
W70-00293

BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
Instituut voor Gezondheidstechniek TNO, The Hague (Netherlands).
J. K. Baars.
De Ingenieur, No 51, p G85-G88, Dec 20, 1968. 3 fig.

Descriptors: *Thermal pollution, *Power plants, *Aquatic life, Ground-water, Nitrification, Oxygen sag, Oxygen requirements, Waste assimilative capacity, Biochemical oxygen demand, Respiration, Aeration, Kinetics.
Identifiers: Fenol.

Thermal pollution of a body of water, as being caused by the disposal of cooling water, has various aspects which under certain conditions can be detrimental to aquatic life. The influence of temperature on the oxygen content of water and its reaction rate with organic materials are major factors. The BOD reaction rate is generally considered to be 4% greater per 1 deg C increase in temperature. Modern power plants have only an efficiency of 33%. The rest of the heat will have to be disposed of. During the summer, as a result of thermal pollution, the oxygen content of the river Thames near Teddington is insufficient for normal aquatic life. Cooling towers can be used in which part of the water evaporates. This results in concentration of organic materials and nitrification, which again can be detrimental to fish life. High temperature increases the rate of breakdown of fenols. If ground-water is used it is generally necessary to add oxygen and remove Fe, H2S, and CO2 before disposal. (Rietveld-Vanderbilt)
W70-00303

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 05B.
W70-00309

THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
North Dakota Univ., Grand Forks.
Joe K. Neel, John W. Vennes, David W. Anderson, James D. Knauss, and Gary L. Buchli.
Completion Report, Sept, 1969. 18 p, 2 fig, 10 ref.

Descriptors: *Saline lakes, Limnology, Nitrogen, Phosphorus, Potassium, Sediments, *Plankton, *Benthos, Midges, Nekton, Salamanders, Bacteria.

Devils Lake, a highly mineralized remnant of a drying larger water body, has a high productivity that is enhanced by municipal wastes. Nitrogen and bicarbonate change with plankton growth and senescence, but this is not apparent for other nutrients. Nitrogen and phosphorus removed from water by phytoplankton are stored in and later released from bottom sediments. Potassium is more critical than nitrogen or phosphorus for algal growth. Sulfate reducing bacteria vary markedly on an annual basis with no significant changes in water chemistry, but nitrifiers and denitrifiers remain rather constant. Benthos m toto was most concentrated in areas with greatest phytoplankton productivity, but this was not true for several species. Midges are the major benthos component. Organic debris incorporated in sediments plays a minor role in benthos distribution. The three most numerous species were influenced by sediment particle size. Tiger salamanders are the most constant and largest nekton element, surviving sporadic oxygen depletions by having adults winter outside the lake. Neotenous forms are subject to 'winter kill', but are present most of the time, developing from eggs in one season. The role of neotenous forms in breeding and conditions governing their development are unknown. Salamanders suffer little predation.
W70-00311

EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
West Virginia Center for Appalachian Studies and Development, Morgantown.
H. A. Wilson, and Keister L. Richardson, Jr.
OWRR Proj A-018-WVA. West Virginia Water Research Institute Information Report 1, 1969. 6 p, 9 ref.

Descriptors: *Acid mine water, Bacteria, *Acid bacteria, Water pollution sources, *Sewage bacteria.
Identifiers: *Bacteria growth, pH determinations.

Five bacterial isolates capable of growing in a synthetic medium with no vitamins or growth factors were used. Three of the isolates were obtained from Monongahela River water (an acid mine water-sewage polluted stream) and two from untreated domestic sewage. The minimum growth pH for two isolates was 3.7 and for the others it was 3.5. A synthetic medium was prepared, dispensed, and adjusted either to minimum growth pH or 0.2 unit below the minimum growth pH. To various portions of the medium amino acids, vitamins, fatty acids, peptone, yeast extract, soil extract, sterilized domestic sewage and a hydrolyzed protein were added singly and in combinations. Except for one combination of two additives, no increase in growth occurred at the minimum pH. With this combination better growth occurred at minimum pH level than in the control (no additives) with the five bacteria. There was some indication that one isolate growth was obtained in the presence of the additives at 0.2 pH unit below the previously determined minimum growth pH. pH determinations were made before and after medium modification, and before and after incubation to ensure no incorrect interpretations because of a pH shift.
W70-00312

STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
Federal Water Pollution Control Administration, West Kingston, R.I.
George R. Gardner, and Paul P. Yevich.
Journal of the Fisheries Research Board of Canada, Vol 26, 1969, p 433-447.

Descriptors: *Fish hematology, Hematology, *Morphology (Blood), Fundulus heteroclitus, *Estuarine fisheries, Estuarine environment.
Identifiers: *Blood cell morphology, Seasonal variation, Thrombocyte function, Stress indicators.

Specimens of Fundulus heteroclitus, Fundulus majalis, and Cyprinodon variegatus were bled in the field at the site of capture. Blood was obtained during all seasons and in the laboratory at intervals over a 30-day period from specimens held in two types of holding aquaria. The circulating blood elements of these three estuarine species consist of erythrocytes, small and medium lymphocytes, eosinophils, and thrombocytes. The observations were made using both stained and fresh blood preparations. Variations occurred seasonally in the morphology of erythrocytes, eosinophils, and thrombocytes. Cytoplasmic inclusions were visible in erythrocytes prior to, and at the beginning of, the new breeding season. There were changes in the refringent properties of thrombocytic and eosinophilic granules, and cyclic variations in the number of eosinophilic granules. Seasonal variations occurred in the ratio of immature to mature thrombocytes, but there was little overall variation in the ratios of leucocytic cell types. The thrombocytes were characterized by thrombocytic granulation and nuclear indentations. Thrombocytes were capable of altering their form; mature cells formed thrombocytic networks. The concentration of eosinophils gradually increased to 18% above the usual level in Fundulus heteroclitus held 30 days in 20-liter circular aquaria. The eosinophil level remained at the usual 2% specimens held in 189-liter aquaria for the same time period. Values for specimens captured in a natural environment were also 2%. It is therefore plausible to relate the rise in eosinophils with an environmental stress associated with the circular holding containers.
W70-00417

5D. Waste Treatment Processes

MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
Oklahoma Univ., Norman. Dept. of Civil Engineering and Sanitary Science.
George W. Reid, Leale E. Streebin, Robert Y. Nelson, and O. Tom Love.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, p 339-350, 1967. 12 p, 1 fig, 3 tab.

Descriptors: *Waste treatment, *Waste dilution, *Water quality control, *Optimization, Mathematical models, Systems analysis, Computer programs, Model studies, Costs, Economics, Streamflow, Water temperature, Biochemical oxygen demand.
Identifiers: Waste treatment-dilution optimization.

Models were developed to depict waste dilution flows used with projections of reservoir and treatment costs to provide optimal combinations of low flow augmentation and waste treatment. Projection of municipal and industrial loadings were developed on a nationwide data base using standard statistical methods. The study revealed mean and variances of strength and discharges. A similar study developed treatment efficiency matrices and corresponding treatment costs. These costs reflected scale effects, and were presented in terms of capital, operation, and maintenance costs. A novel technique employing micro and macro models and 'tunneling' procedure was used to disaggregate national values and to provide basin loading level forecasts. Stream input-output models were developed in terms of responses to impressed loads, characterized as biodegradable, nutritional, persistent chemical, and thermal. The models were developed as a function of stream parameters. The loads and stream resources were treated on a basin level in these macro level models. The model provides optimal or least cost combination of waste treatment and dilution. (Knapp-USGS)
W70-00064

CONTROL OF MINE DRAINAGE WATER,
Pennsylvania State Univ., University Park. Dept. of Mineral Preparation; and Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 05G.
W70-00069

ECONOMIC SIZING OF COOLING TOWERS,
Electricity Supply Board (Ireland).
A. G. Kelly, and N. R. Lawless.
Combustion, p 41-47, Aug 1962. 12 fig, 2 tab, 6 ref.

Descriptors: *Cooling towers, Weather charts, Thermal pollution, Thermal powerplants.
Identifiers: *Natural draft towers, Turbo-set heat consumption, Turbo-alternator efficiency, Cooling tower size, Weather analysis.

An accurate method of producing a weather specification for natural draft cooling towers is deduced. A size of cooling tower and condenser is chosen which will give the best value for money invested. The operating cooling water temperatures for every hour of the life of the plant are taken into consideration in the economics of choice of condenser and cooling tower. The analysis showed that the weather conditions are an effective 5 deg. to 7 deg. F more in favor of the tower than was heretofore thought. On first sight this might appear to make it economic to construct smaller cooling towers but, in fact, the opposite is true. Cooling towers give a good return in efficiency for extra investment; because towers are now known to produce colder water (and thus better heat consumption of the turbo-set) when actual average atmospheric conditions are fully analyzed, it is economic to build larger towers than heretofore. (Ross-Vanderbilt)
W70-00155

CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
National Bureau of Standards, Washington, D.C.
For primary bibliographic entry see Field 02D.
W70-00156

USUAL APPLICATIONS OF COOLING TOWERS,
Foster Wheeler Corp., San Mateo, Calif.
J. J. Finnerty.
Industrial Water and Wastes, p 187-190, Nov-Dec, 1961. 5 fig, 1 ref.

Descriptors: *Cooling towers, *Thermal pollution, Waste water (Pollution), Heated water, Water reuse.
Identifiers: Counterflow cooling tower, Standby cooling tower, Salt water cooling.

That cooling towers efficiently and effectively conserve water while removing waste heat, both paramount objectives of industry is emphasized. Recent industrial expansion has created new and diverse cooling tower applications, three of which are described, all induced-draft counterflow cooling towers. In the first, salt water, rather than fresh, is cooled in the tower. The second tower, serving a condenser, in effect cools the river from which the circulating water is drawn. In the third application, the tower is used as a process instrument, removing excess heat from a waste flow to enable biological treatment. Details of these applications are given. (Ross-Vanderbilt)
W70-00157

COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
Southern California Edison Co., Los Angeles, Calif.
R. W. Spencer, and John Bruce.
Journal of the Power Division, Proceedings of the American Society of Civil Engineers, Vol 86, No PO 3, p 1-26, June 1960. 23 fig.

Descriptors: *Electric power plant, *Cooling water, *Tidewater, Thermal pollution, Calfiornia.
Identifiers: Steam electric station, Steam generating station.

A number of tidewater installations mostly in California are briefly reviewed in lieu of analysis of the detail of mechanical and hydraulic features of cooling water systems. Sites include: Mandalay, El Segundo, Long Beach, Redondo, Huntington Beach, Alamitos, Pittsburgh, Moss Landing, Morro Bay, Hunters Point, Contra Costa, Humboldt Bay, Encina (Carlsbad), Silvergate, Seal Beach, Los Angeles Harbor. Although the availability of cooling water has been a major factor in the selection of plant sites, the designer is usually faced with making a choice of several alternate cooling water arrangements after the site is purchased. There has been a steady improvement in the design of cooling water systems over the past 30 years. Desirable station sites are becoming difficult to obtain in many areas. A variety of methods have been used successfully in meeting operating problems encountered, such as sand movement, marine growth control, and fish destruction. (Ross-Vanderbilt)
W70-00159

SEA PLANTS FOR FOOD,
Southampton Univ. (England).
For primary bibliographic entry see Field 03C.
W70-00161

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
American Water Works Association Research Foundation, New York.
For primary bibliographic entry see Field 05E.
W70-00162

ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A Pilot Study of Treating Combined Chrome Tannery Wastes and Domestic Sewage.
Lawrence (A. C.) Leather Co., South Paris, Maine.

Available from the Clearinghouse as PB186 158. $3. in paper copy, .65 cents in microfiche. Water Pollution Control Series, FWPCA Report ORD-5, Sept 1969. 174 p, 48 tab, 36 fig, 13 ref, append. Grant No WPRD 133-01-68. FWPCA Program No 12120.

Descriptors: Pilot plants, Chromium, Sulfides, *Waste treatment, Industrial wastes, *Municipal wastes, Sludge, *Activated sludge.
Identifiers: *Tannery wastes.

The A. C. Lawrence Leather Company tannery at South Paris, Maine is a chrome side upper leather tannery. About 220 people are employed at the tannery and about 2,500 hides are processed each day. The water use at the tannery is about 1.0 mgd. Each day the waste discharged from the tannery contains about 8,500 lbs of 5-day, 20 deg C BOD, 70,000 lbs of total solids, of which about 17,000 lbs are suspended and 53,000 lbs are dissolved. The pH of the wastewater varies from 5.0 to 12.0. The daily waste discharge also contains about 8,000 lbs of calcium, as $CaCO_3$, 300 lbs of sulfides, and 1,800 lbs of chromium. A waste treatment process was developed and tested, in pilot plant scale, for the treatment of the tannery wastes in combination with municipal sewage. The process consisted of the following steps in the order employed; equalizing and mixing of the alkaline and acid wastes; primary sedimentation; carbonation followed by upflow sedimentation; addition of screened municipal sewage; activated sludge treatment and secondary sedimentation of the mixed wastes; and chlorination. The sludges resulting from the treatment of the wastes and sewage were dewatered by centrifuge and were found to be suitable for burial. Design factors for the various steps of the process were developed and are presented in the attached report. Studies were made of the fundamental systems and reactions which form the bases for the processes employed in the pilot plant. The results of the pilot plant investigation indicate that by use of the methods recommended, mixtures of chrome tannery wastes and municipal sewage can be treated successfully. It may be anticipated that by the employment of the methods recommended, that mixtures of tannery wastes and municipal sewage can be treated to remove more than 90 percent of the BOD and suspended solids together with about 65 percent of the total solids. Furthermore, the treatment will remove or convert 99 to 100 percent of the sulfides, remove about 97 percent of the chromium and about 65 percent of the calcium. Chlorination of the effluent will reduce the coliform bacteria concentration to less than 100 per 100 ml. The processes recommended are conventional sewage treatment unit processes, with the exception of carbonation and solids contact sedimentation. Modification of conventional equipment will be necessary to accommodate the special characteristics of tannery wastes. Fine screening will be needed to remove hair. Calcium carbonate incrustation of equipment, especially screens and carbonation equipment, will have to be considered. Extra strength sludge collection and pumping equipment will be needed since the sludges are large in quantity and are denser than sewage sludges.
W70-00163

RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
Central Electricity Generating Board, London (England). Central Electricity Research Labs.
L. O. Wild.
CEGB Technical Disclosure Bulletin, No 41, Nov, 1964. 3 p, 3 fig.

Descriptors: *Cooling towers.
Identifiers: *Kinetic energy, Velocity component.

This report is based on the work carried out at CEGB, U. K. on the recovery of energy from cooling towers and is useful for typical large cooling towers where water might have to fall 30 feet. If the liquid from a cooling tower is allowed to fall onto a flat surface, all the kinetic energy is dissipated as heat. If a cone is used in place of a flat surface the liquid will run down the surface in radially outward direction and could be collected in a culvert around the base of the cone, but the acquired kinetic energy would be destroyed against the wall of the cone. If the cone is modified so that the semi-angle of the cone is gradually increased as one goes round the surface of the cone then at any point the line of greatest slope is no longer radial but has a circumferential component. The culvert would have a slope and cross-section to suit the flow and velocity required. To maximize circumferential component of velocity the apex of the cone would preferably be at the maximum possible height. (Upadhyaya-Vanderbilt)
W70-00316

REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. G. Christie.
CEGB, Technical Disclosure Bulletin, No 106, May, 1968. 3 p, 1 fig.

Descriptors: *Cooling towers.
Identifiers: *Crossflow cooling tower, *Pump head, Thermal design, Pump power.

It is shown that by splitting the packing of a cross flow cooling tower into two sections vertically one above the other, a saving of up to 40% of the tower pumping head can be achieved. It is shown that required pump power in case packing is (40+ Y1+ 1/2 H) W. ft lb/hr and the corresponding value for the single packing is (40+ Y2) W. ft lb/hr. Y2 and Y1 are the height of the tower in non-splitting and splitting the packing, H is head (2-3 ft) required to allow for the flow resistance in downcomer from the upper packing and W is the total water flow in lb/hr through the tower. Taking practical values of 66 and 37 ft. for Y2 and Y1, the saving in pumping head for the split pack tower is 28 ft. The overall packing height must be increased to maintain the thermal performance, but the capital cost of the tower is substantially the same since a thinner packing is technically acceptable. (Upadhyaya-Vanderbilt)
W70-00320

STATUS OF BIG COOLING TOWERS,
Marley Co.
For primary bibliographic entry see Field 08A.
W70-00321

5E. Ultimate Disposal of Wastes

EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
Illinois State Geological Survey, Urbana.
Keros Cartwright, and Frank B. Sherman.
Ill State Geol Surv Environ Geol Note No 27, Aug 1969. 15 p, 3 fig, 13 ref.

Descriptors: *Landfills, *Environmental sanitation, *Illinois, *Hydrogeology, Sanitary engineering, Waste disposal, Geology, Groundwater movement, Surface waters, Glacial drift, Aquifers, Aquicludes.
Identifiers: Illinois sanitary landfills.

Criteria for the suitability of sites for sanitary landfill in Illinois are listed and discussed. Both surface water and groundwater must be protected from leachates containing large organic and bacterial loads. Landfills should be located in relatively impermeable material so that leachate movement is retarded. Clay, shale, silt, and glacial till are the most common materials with low permeability in Illinois. At least 30 ft of impermeable material is required between the bottom of a landfill and the shallowest aquifer. Choice of proper site topography is important in avoiding surface drainage contamination. Limestone or dolomite quarries and most sand and gravel pits make poor landfill sites because these materials are usually good aquifers. Swampy areas also make poor sites unless they are properly drained to prevent disposal into standing water. Strip mines, clay pits, and gravel pits containing gravel with a high percentage of natural clay binder (the type that is often used for grading county roads) do make good disposal sites if kept dry. Flat upland areas also are good potential sites if the required natural clay barrier is present above any aquifer. The careful selection of a landfill site will result in a minimum of operating problems and little, if any, danger of groundwater or surfacewater pollution. (Knapp-USGS)
W70-00006

POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
For primary bibliographic entry see Field 05G.
W70-00093

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
American Water Works Association Research Foundation, New York.

Available from the Clearinghouse as PB186 157, $3. in paper copy, .65 cents in microfiche. Water Pollution Control Series, FWPCA Report ORD-2, Aug, 1969. 184 p, 7 tab, 30 fig, 195 ref, subject index. Project No WP1535-01-69. FWPCA Program No 12120 ERC.

Descriptors: *Waste disposal, Waste treatment, *Water treatment, Sludge treatment, Ultimate disposal, Operation and maintenance, *Cost analysis, Regulation, Surveys, *Utilities, Water works.

This report is an intensive study of the disposal of wastes from water treatment plants. The wastes include filter washwater; sludge resulting from coagulation, softening, iron and manganese removal processes; diatomaceous earth filtration; and ion exchange brines. The control of pollution from these wastes is a high priority problem for the water utility industry. A series of four status reports describe in detail what is known of the research, engineering, plant operation, and regulatory aspects of the problem. A special report reviews current technology and analyzes costs of disposal methods, based on data collected from fifteen operating plants. A conference was organized to provide expert evaluation of each report and to extend the data available. Final reports were prepared by committees of conference participants to identify future needs for information in each aspect of the waste disposal problem. These reports recommend substantially expanded programs of research and demonstration. They include extensive lists of specific problems which must be investigated to develop effective and economical technology. Committee reports also recommend establishment of a central service to promote the planning of research and development, and to implement effective programs of new or improved technology. The service would collect, coordinate, and disseminate data on all aspects of water treatment plant waste disposal problems.
W70-00162

CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
249 SW2d 347-356 (Mo 1952).

Descriptors: *Missouri, *Local governments, *Water rates, *Waterworks, Sewage disposal, Sewerage, Utilities, Sewers, State governments, Judicial decisions, Remedies, Legal aspects, Financing.

Pursuant to the authority granted by an act of the Missouri legislature, the city of Maryville combined its waterworks and sewerage systems. In a special election, it chose to issue and sell revenue bonds to defray the cost of improving and extending this combined system. The bonds and interest were to be paid out of the funds collected for the use of the combined system. A group of taxpayers, water users and sewer users filed a petition praying that the bonds be held invalid. Following a decree finding the bonds valid, they appealed. The court affirmed this decree. It held: (1) that respondent could charge for the use of the sewerage system regardless of whether such system had previously been maintained through taxes; (2) that respondent could legally make an owner liable for the water and sewerage services rendered to a tenant on the owner's premises; and (3) that respondent was authorized to discontinue water service upon a failure to pay the fixed charges within a reasonable time. (Gabrielson-Florida)
W70-00382

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
For primary bibliographic entry see Field 05G.
W70-00397

5F. Water Treatment and Quality Alteration

OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS,
Department of Water and Power, Los Angeles, Calif.
L. T. Mariner, and W. A. Hunsucker.
Journal of Power Division, Proceedings of the American Society of Civil Engineers, Vol 85, No PO 4, Aug 1959. 21 fig.

Descriptors: *Thermal power plants, *Cooling water, Design, Construction, Dewatering, Flood protection, Fish repellent.
Identifiers: Los Angeles, Scattergood Steam Plant, Haynes Steam Plant.

Varied problems are compared associated with the design and construction of circulating water facilities for two coastal themal plants to serve the city of Los Angeles. Widely differing locations pose diverse design problems of sanding, erosion, and navigational requirements. Construction dewatering problems are illustrated and discussed. The Scattergood Steam Plant on Santa Monica Bay and the Haynes Steam Plant are compared. The circulating water system for the Scattergood Cooling Plant is designed for cooling the first four power units. Although space is provided for a six-unit plant, it is estimated that there will be major changes in the design of thermal generating units before the last two are required. At the Haynes Plant cooling water will pass through substructures under the San Gabriel River and Pacific Coast Highway into an open channel leading to the plant site. Integrated screening and pumping facilities for the ultimate development are not contemplated for this plant. Each unit or pair of units will have a separate installation for this purpose. (Ross-Vanderbilt)
W70-00160

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
Black and Veatch, Kansas City, Mo.

Office of Saline Water Research and Development Progress Report No 462, October 1969. 49 p. OSW Contract 14-01-0001-1777.

Descriptors: Chemical analysis, *Water quality, *Municipal water, Domestic water, *Public health.
Identifiers: Substandard quality water supplies, *Total dissolved solids.

The report presents listings by states and by water resource regions of the community water systems, 420 in number for the United States, having reported water supplies with high mineral content. The listings are restricted to communities of population 1,000 or over, and to supplies containing 1000 ppm of TDS or over. For 284 of the communities, all sources feeding into the water supply have over 1000 ppm of TDS. The 420 communities listed represent a 1960 population in excess of 2,770,000. (Bovet-Office of Saline Water)
W70-00308

5G. Water Quality Control

CONTROL OF MINE DRAINAGE WATER,
Pennsylvania State Univ., University Park. Dept. of Mineral Preparation; and Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Harold L. Lovell, and Bruce E. Jones.
Proc 3rd Annu Amer Water Resources Conf, Nov 8-10, 1967, San Francisco, Calif, p 578-587, 1967. 10 p, 4 fig, 2 tab.

Descriptors: *Acid Mine water, *Water pollution control, Waste water treatment, Neutralization, Ion exchange, Biodegradation, Oxidation, Water pollution treatment, Abatement, Water quality control, Pilot plants.
Identifiers: Acid mine drainage control.

Coal mine drainage creates a stream contamination problem which currently plagues several eastern states. It introduces iron, aluminum, and sulfate ions as well as sulfuric acid into receiving streams and frequently produces unsightly sediments on stream bottoms. These constitute an environment which is generally incompatible with aquatic life, recreational use, and industrial water requirements. Such pollution develops naturally under proper environmental conditions but is enhanced by mining operations. Recently adopted state laws and regulations require immediate and extensive remedial action in certain areas. Corrective approaches to these pollution conditions include prevention of its formation, amerioration, diversion to areas where the contamination might be less innocuous and water treatment for removal of the contaminants. At the present time, one of the approaches being taken by the Pennsylvania State University is the construction of a versatile experimental plant for treating such waters. This plant will be capable of treating half a million gallons of water per day and will utilize 6 separate neutralization flow paths. Such data are essential to obtain the economic information for optimizing design and operational procedures. (Knapp-USGS)
W70-00069

POLLUTION CONTROL AMENDMENTS URGED.

Am Forests, Vol 62, No 1, p 23, Jan 1956. 1 p.

Descriptors: *Pollution abatement, *Water pollution control, *Legislation, *Federal government, Conservation, Policy, Water quality control, Natural resources, Water pollution, Public benefits, Administrative agencies.

In December 1955, a meeting was held by the National Wildlife Federation in order to promote the extention and revision of the federal Water Pollution Control Act. Members of the Natural Resources Council asked the Department of Health, Education, and Welfare to give this bill its full and undivided attention. The group also asked the Department to resist any efforts to weaken the bill as pending. (Heckerling-Florida)
W70-00086

POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
Ind Ann Stat sec 48-4207 (1963).

Descriptors: *Indiana, *Pollution abatement, *Sewerage, *Pollutant identification, Legislation, Legal aspects, Streams, Sewage disposal, Cities, Rivers, Drainage, Watercourses (Legal), Drainage systems, Public health, Public benefits, Structures, Pumping plants, Specifications, Right-of-way, Investigations, Construction, Financing, Drains, Sewers, Environmental sanitation, Water pollution, Waste disposal, Sanitary engineering.
Identifiers: *Sewage disposal plants.

When the Board of Sanitation Commissioners of any city located on or near any watercourse finds upon investigation that such watercourse is being polluted by sewage or drainage system discharge from such city, it must determine whether the construction of a sewage disposal system is necessary for the public health and benefit. If a new disposal system is deemed necessary, the board prepares maps, plans, specifications, and drawings for the proposed plant together with an estimate of the installation costs of the plant and all structures incident thereto. The board must also prepare a description of all property rights to be acquired in connection with such plant whether such rights are to be obtained by purchase or appropriation. The board must then propose a resolution incorporating the findings of its original investigation as well as all pertinent maps, plans, specifications, and descriptions. The procedures for adoption of the resolution, financing the plant, having public hearings on the resolution, and acquiring the necessary property are all specifically set out. (Keith-Florida)
W70-00093

INTERSTATE WATER SANITATION BOARD.

Ky Rev Stat Ann secs 224.205, 224.210 (Supp 1968).

Descriptors: *Kentucky, *Interstate compacts, *Water pollution control, *Interstate commissions, Legislation, Basins, Rivers, Interstate rivers, Ohio River, Administrative agencies, Legal aspects.
Identifiers: *Water sanitation.

An Interstate Water Sanitation Board is established. The members of the Board shall serve as Kentucky's members of interstate water sanitation control commissions created by compacts to which Kentucky is a party, which compacts are composed of states forming a river basin, and which compacts require a three-member representation from each state. The interstate water sanitation control commissions created by such compacts shall have all the powers provided for in the respective compacts, and all the powers necessary or incidental to the carrying out of the compacts in every particular. Any powers granted to the commissions by this section shall be regarded as in aid of and supplimental to and not as a limitation upon any of the powers vested in the commissions by other laws of this state or by the laws of any of the states party to any of the compacts, or by Congress, or by the terms of the compacts. (Heckerling-Florida)
W70-00107

DUTIES OF THE DEPARTMENT OF CONSERVATION.

Ind Ann Stat secs 60-718 thru 60-720 (1962).

Descriptors: *Water conservation, *Indiana, *Wildlife conservation, *Water pollution control, Legislation, Legal aspects, Drainage, Eminent domain, Lakes, Streams, Springs, Water pollution, Sewage disposal, Regulation, Administrative agencies, Conservation, Navigable waters, Fish, Permits, Beds, Public health, Public utilities, Riparian rights, Riparian land, Right-of-way, Parks, Fish management, Fish conservation, Fish reproduction.
Identifiers: *Penalties (Criminal).

The duties of the department of conservation are: to employ convicts for the purpose of draining lands acquired by the state for parks; to investigate lakes, streams, and springs for the presence of pollution and to prevent further pollution by the promulgation of necessary regulations; to have general charge and supervision of the navigable waters of the state; and to issue permits for the taking of minerals from or under the bed of any of the navigable waters of the state when the operations under such permit will not impede navigation or endanger any public structures or the property of any riparian owner. All lands owned by the state which are adjacent to any lake or stream are placed under the control and management of the department of conservation, except that the state reserves the right to convey rights of way to public utilities. The division of fish and game has the following duties: examination, testing, and carrying out methods for fish and game reproduction; acquisition or construction of equipment for the foregoing duty; and enforcement of wildlife protection laws. (Keith-Florida)
W70-00135

SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),
Gosudarjtvennyi Geologicheskii Institut, Leningrad (USSR).
A. V. Karaushev.
Materialy po voprosam samoochishcheniya vodoyomov i smeshcheniya stochnikh vod, Tallinn Pol Inst, p 5-27, June 7-10, 1965. 24 ref.

Descriptors: *Turbulence, *Mixing, *Waste dilution, Water pollution, Mathematical models, Hydraulic models, Mass transfer, Waste water (Pollution).
Identifiers: Turbulent mixing coefficient, Wind effect.

Applicability of sediment movement laws to the problems of waste dilution in streams is discussed and a new approach developed. The solution to the waste dilution problems is based on Makkareev's formula of turbulent diffusion in streams. Including wind effect in computation of the turbulent mixing coefficient for reservoirs and lakes is proposed, and an analytical approach presented. Uses of hydraulic models and problems of model similarity for dilution of waste waters in streams are discussed in the end of the paper. (Novotny-Vanderbilt)
W70-00151

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).

185 Va 758, 40 SE2d 298-305 (1946).

Descriptors: *Virginia, *Acid mine water, *Riparian rights, *Water pollution, Judicial decisions, Acidity, Corrosion, Water pollution effects, Coal mine wastes, Effluents, Mine acids, Mine wastes, Water pollution sources, Reasonable use, Water rights, Riparian land, Acid streams, Mine drainage, Percolating water, Water law.

Plaintiff is lower riparian land owner. Defendant coal company mines upper land upon which the stream flowing through plaintiff's land arises. Seeping and percolating mine water flows naturally into the stream. The mine water contained acids and minerals sufficient to injure and kill vegetation. Plaintiff claims that the stream and water wells located on his land were damaged. An upper riparian owner does not have a legal right to pollute to a material degree the stream running through a lower owner's land. The lower owner has a cause of action only when an unreasonable use of land and water by the upper land owner renders the water flowing into his land unfit for the use for which it had once been suitable and actually put. The court found the defendant not liable because the plaintiff had caused stream pollution himself and was unable to prove what proportion of the pollution was attributable to defendant. (Helwig-Florida)
W70-00167

WATER POLLUTION CONTROL.
Vt Stat Ann Tit 10, secs 901-918 (1958), as amended, (Supp 1968).

Descriptors: *Vermont, *Water pollution, *Water pollution control, *Classification, Legislation, Legal aspects, Recreation, Irrigation, Navigation, Pollution abatement, Reservoirs, Water resources, Permits, Water quality, Drainage, Cities, Rivers, Streams, Ponds, Lakes, Springs, Surface waters, Swimming, Watersheds (Basins), Water utilization, Sewage, Water supply.
Identifiers: Agricultural uses, Penalties (Criminal).

'Pollution' is the placing in the waters of the state of any noxious or deleterious substance which is likely to create a nuisance or which renders such waters harmful to animal or aquatic life or unfit for domestic, commercial, industrial, or recreational uses. The terms 'waters' includes artificial and natural bodies of surface water within the state. Water is classified as follows: class A water is suitable for public supply with disinfection and is of uniformly excellent character; class B water is suitable for bathing, recreation, irrigation, agricultural uses, and is acceptable for public supply with filtration and disinfection; class C water is suitable for recreational boating, wildlife habitat, and other specified uses; and class D water is suitable for power, navigation, transportation of sewage, and other specified uses. To implement compliance with the New England Interstate Water Pollution Control Compact and to effectuate a program for the prevention, control, and abatement of pollution, it is specified which state waters fall into each of the foregoing categories. A permit is required to create or maintain a source of pollution. The manner of the regulation, administration, and enforcement of the classification system is specified. (Keith-Florida)
W70-00168

CHICAGO SANITARY DISTRICT.

Ill Ann Stat ch 42, secs 326, 326aa, 326bb, 329a, 330, 336, 337, 339, 341, 342, 344-349, 351, 352, 354-359 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Sewage treatment, *Drainage systems, *Water pollution, Legislation, Administration, Administrative agencies, Drainage, Municipal wastes, Sewage disposal, Cities, Pollution abatement, Treatment facilities, Channels, Channel improvement, Engineering structures, Sewage, Waste water (Pollution), Assessments, Water resources, Eminent domain, Flood control, Regulation, Permits, Water control.
Identifiers: *Sanitary districts.

The authority of sanitary districts includes jurisdiction over drainage, sewage, and treatment works within their respective territories. Districts are charged with prevention and abatement of pollution by establishing standards, requiring permits for construction of municipal sewage systems and for changed systems, and initiating court action against violators. Financing of projects may be through sale of bonds. Authority of districts includes building docks, highways, bridges, approaches, and other works related to drainage canals and channels, and existing waterways may be improved to facilitate drainage. Districts have the power of eminent domain in most instances and are held liable for all damage caused by improvements. Specifications are made for size and capacity of sewage and drainage watercourses, for restrictions on the type of sewage discharge allowed, and for connecting facilities between districts. Districts which violate the act are subject to court action initiated by the Attorney General. Municipalities are required to share water sources that have been saved from pollution with other cities. There is provision for inspection of new channels. The city of Chicago is organized as a drainage district, and the statutory powers are conferred on the corporate authorities. (Douberley-Florida)
W70-00171

CHICAGO SANITARY DISTRICT.

Ill Ann Stat ch 42, secs 326, 326aa, 326bb (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Sewage treatment, *Drainage, *Sewage disposal, *Pollution abatement, Sewage, Sewage effluents, Waste water (Pollution), Surface drainage, Sewers, Regulation, Permits, Water control, Wastes, Municipal wastes, Waste water disposal, Waste water treatment, Cities, Docks, Water pollution, Water pollution treatment, Impaired water quality, Pollutant identification, Standards, Treatment facilities, Water quality.
Identifiers: *Sanitary districts.

Sanitary district trustees provide for drainage of surface water and sewage as well as for sewage disposal and treatment works. They also establish docks adjacent to navigable drainage channels, establish rates and charges therefore, and control water power which is incidentally created in the construction and use of channels, but do not control water after it passes the district's facilities. The Board of Trustees may prevent pollution of any source of water supply by mandamus or injunction proceedings. The Board may require municipalities to submit plans and specifications for approval before construction of sewers connecting with those of the district. The Board of Trustees determines what discharges constitute pollution and establishes standards within those set by the Sanitary Water Board. The Board has a duty to determine ways and means of removing and abating pollution. A permit from the Board is required for installation of any sewage system that discharges wastes into district waters and for changes in systems of large municipalities. When pollution occurs the Board may order discharge discontinued after notice and hearing. (Douberley-Florida)
W70-00172

CHICAGO SANITARY DISTRICT.

Ill Ann Stat ch 42, secs 329a, 330, 336, 337, 339 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Sewage disposal, *Engineering structures, *Drainage systems, *Sewage, Drainage, Sewers, Financing, Docks, Channels, Canals, Condemnation, Eminent domain, Condemnation value, Right-of-way, Channel improvement, Drainage water, Treatment facilities, Bridges, Cities, Compensation, Highways.

Sanitary districts may construct or improve sewage or drainage systems in a particular locality and finance the improvements through the sale of bonds. Specifications are provided for issuance of bonds. Districts may build and maintain highways along canals and channels where it is necessary to make dock property owned by the district accessible for use. These highways may be conveyed or released to the state. After proper proceedings, districts may condemn and acquire private property which is necessary to make improvements authorized by this chapter. Districts may acquire rights-of-way over public property and may improve any waterway, canal, lake, or other waters, including straightening of watercourses used for drainage. Plans for improvements must be approved by the Department of Public Works and Buildings. Districts may acquire existing sanitary facilities, but only by means other than condemnation. Provisions are made for bridges over certain channels, approaches, viaducts, subways, roadways, and sidewalks. These structures are to be turned over to municipalities if within their corporate limits. Districts are liable for any damage caused by any improvements, provided the district concerned is notified prior to suit. (Douberley-Florida)
W70-00173

CHICAGO SANITARY DISTRICT.

Ill Ann Stat ch 42, secs 341, 342, 344-347 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Channel improvement, *Drainage systems, *Waste water (Pollution), Channel flow, Drainage, Drainage practices, Sewage, Channels, Navigation, Navigable waters, Regulation, Sewers, Waste water disposal, Impaired water quality, Assessments, Taxes, River flow, River regulation.

Any channel or outlet discharging sewage into waters outside the sanitary district which constructed it must be of a specified size and capacity. Discharges must be such that the waters will be free of solids and will not be offensive or injurious to health. The Attorney General may institute suit against any district not complying with the act. Districts may levy an emergency tax if necessary to comply with improvements or changes decreed by the court. Minimum capacity is set for channels that divert Lake Michigan waters into various rivers, and districts have authority to remove obstructions in those rivers to prevent overflowing. Existing power rights are not affected. Channels are under the control of the general government for navigational purposes. Any district may provide for works in the Great Lakes or in connecting watercourses outside its territory for purposes of complying with the act. Districts may agree on terms and conditions for drainage from outside territories into its channels and for use of outside drains or channels. Specifications are established for the united flow from two districts. (Douberley-Florida)
W70-00174

CHICAGO SANITARY DISTRICT.

Ill Ann Stat ch 42, secs 348, 349, 351, 352, 354-359 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Channel improvement, *Flood control, *Drainage systems, *Water control, Cities, Costs, Cost-benefit theory, Cost allocation, Water quality, Water resources, Water supply, Channels, Inspection, On site investigations, Testing, Condemnation, Eminent domain, Bridges, Cutoffs, Flood routing, Dams, Diversion structures, Water pollution treatment, Right-of-way, Maintenance.

Any municipality whose water source will be saved from pollution by construction of facilities under this act shall provide water to other municipalities as needed at the same rates charged other customers, unless facilities must be built outside its corporate limits and a higher rate is justified. No water or sewage may be admitted to a newly constructed channel before a board of commissioners certifies it to be in accordance with the provisions of this act. Sanitary districts may acquire land by purchase or eminent domain for the widening and deepening of streams which are to be used as channels. Bridges may be constructed where made necessary by such improvements. The City of Chicago is organized as a sanitary district, and the powers conferred by the act are conferred on the corporate authorities. They are authorized to construct a cut-off drain to divert flood water into Lake Michigan and to construct certain dams. Corporate authorities have the power to acquire property and rights-of-way necessary for the maintenance of authorized works. Cost of improvements is defrayed by assessing property within the district that is benefitted by the improvement. (Douberley-Florida)
W70-00175

STRIP MINING.

Ky Rev Stat Ann secs 350.020, 350.050, 350.060, 350.085, 350.090, 350.093, 350.100, 350.170, 350.240, 350.990 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Strip mines, *Mine drainage, *Strip mine wastes, Acid mine water, Cooling water, Fouling, Impaired water quality, Landfills, Mining, Pollutants, Public health, Soil contamination, Waste water, Water pollution sources, Water pollution effects, Seepage, Erosion, Sedimentation, Soil conservation, Drainage systems, Erosion control, Flood protection, Pollution abatement, Permits, Legislation.
Identifiers: *Anti-pollution legislation, Mining regulations, Penalties (Civil), Penalties (Criminal).

A Reclamation Commission was created to rigidly enforce regulation of and supervision of strip mining after findings that unregulated strip mining of coal counteracts efforts for soil and water conservation and causes erosion, pollution, and flooding. The Commission is given broad discretionary power to investigate, research, inspect, and rule upon issues created in this chapter. Permits are made necessary for strip mining in the state and applications for such permits must include a map of the course to be taken by drainage from the mine. If the mining project constitutes a hazard to streams or lakes in the area or is within one hundred feet of any public stream or lake, the permit will be denied. A proposed reclamation plan, including measures to eliminate damages to public property from erosion, pollution, and flooding, must be submitted and carried out by complete backfilling within twelve months after the permit has expired. These same requirements may be adopted for the mining of clay. Penalties, both civil and criminal, are proposed for any violation of the provisions of this chapter. (Schram-Florida)
W70-00177

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.

Ky Rev Stat Ann sec 224.195, 224.200 (Supp 1968).

Descriptors: *Water pollution, *Kentucky, *Interstate compacts, *Tennessee River, Rivers, Water pollution control, Pollution abatement, River basin commissions, Administration, Administrative agencies, Legislation, Legal aspects, Governments, State governments, Water treatment, Standards, Water quality, Water pollution, Regulation, Sewage treatment, Water utilization.

The purpose of this compact is to promote effective control and reduction of pollution in the waters of the Tennessee River Basin through increased interstate cooperation. A district consisting of the area drained by the Tennessee River is created and a commission is established to manage, plan, inspect, render advise, and draft legislation concerning pollution in the river basin. The Commission shall prescribe regulations designed to further this compact. Although no single standard for sewage treatment or water quality will be appropriate for all situations, the Commission shall establish those standards that are best suited to the area involved

and the use of the water. The individual member states will work to establish water treatment programs designed to meet these standards. Also, any state pollution control agency may certify to the commission an alleged violation of the existing standards. After hearing, the Commission shall recommend appropriate measures to the state agency. If the violation does not cease, then the Commission holds further hearings and may order compliance with their findings. These orders may be enforced in the appropriate courts by specific relief suits. (Darragh-Florida)
W70-00178

TORTS - NUISANCE: INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
B. E. Ross.
Ark L Rev, Vol 19, No 3, p 407-409, Fall 1966. 3 p, 28 ref.

Descriptors: *Arkansas, *Riparian rights, *Water pollution, *Commercial fishing, Judicial decisions, Water users, Pollution abatement, Remedies, Damages, Streams, Non-navigable waters, Fishkill, Land tenure, Water pollution sources, Water pollution effects, Water pollution control.
Identifiers: *Nuisance (Public), *Nuisance (Private).

In Carson v Hercules Powder Co, 402 S.W. 2d 640 (1966), plaintiff, a commercial fisherman, had permission from the riparian owners to fish along a non-navigable stream. It was established that defendant polluted the stream, killing the fish, and preventing plaintiff from continuing his fishing. The Arkansas Pollution Control Commission had previously found defendant's pollution to be a public nuisance and had enjoined further pollution. Plaintiff asked for damages and injunctive relief. The trial court held testimony insufficient to justify an injunction and denied damages. The appellate court reversed and remanded, holding plaintiff entitled to damages for loss of earnings and damages to his business. The problem in this case concerns the types of interests which will sustain an action for nuisance. Unless the plaintiff has some interest in the property affected, he may not prevail in a private nuisance action. Any interest which can be deemed a property right will support the action. The action in the principal case might have been sustained on either a private nuisance or private action for a public nuisance theory. The court apparently adopted the plaintiff's contention that he was a tenant at the will of the riparian owners, and therefore had the requisite possessory interest to sustain the action. (Heckerling-Florida)
W70-00181

RIVERS STREAMS AND WATERWAYS.

Ind Ann Stat sec 48-5511 (1963).

Descriptors: *Local governments, *Administrative agencies, *Parks, *Indiana, Maintenance, Rivers, Streams, Assessments, Legislation, Bridges, Tunnels, Bank protection, Levees, Flow control, Pollution abatement, Water pollution control.

The Board of Park Commissioners of any city shall have the power to keep open and clean rivers and streams bordering on or running through any public park. They may improve the banks of such waters, build levees, control water flow, and promulgate rules and regulations required for such purposes. They may construct all necessary bridges over or tunnels under such waters within public parks. Owners of real estate abutting such waters may be required to maintain the waters free of objectionable pollutants. If such owners fail to comply, the Board may cause such objectionable materials to be removed, and upon certification of such removal the county treasurer shall assess the cost to the property owner. (Darragh-Florida)
W70-00186

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
Harza Engineering Co., Chicago, Ill. Water Resources Planning Div.; and Metropolitan Sanitary District of Greater Chicago.
Istavros S. Papadopulos, William R. Larsen, and Forrest C. Neil.
Ground Water, Vol 7, No 5, p 3-15, Sept-Oct 1969. 13 p, 16 fig, 4 tab, 10 ref.

Descriptors: *Water storage, *Hydrogeology, *Storm runoff, *Cities, *Illinois, Waste water treatment, Waste water disposal, Groundwater, Water levels, Seepage, Discharge (Water), Hydrologic data, Aquifers, Pumped storage, Analog models.
Identifiers: *Chicago Deep Tunnel Plan.

The Deep Tunnel System planned by the Metropolitan Sanitary District of Greater Chicago will provide flood and pollution control for the combined sewer areas of the Chicago region. Elements of the Deep Tunnel System that are of main concern to the groundwater resources of the area are the conveyance tunnels and the mined storage reservoir which will convey and store polluted storm-water overflows. The Silurian and the Cambrian-Ordovician aquifers, in units of which these elements will be located, will be protected from any deleterious effects of the System by ensuring that a positive hydraulic head, causing an inward flow, is continuously maintained around the tunnels and the mined reservoir. In the Cambrian-Ordovician aquifer, this necessitates that groundwater levels are maintained by artificial recharge. Extensive groundwater studies were conducted to (1) demonstrate the feasibility of aquifer protection by recharge, (2) determine the needed amounts of recharge water, and (3) estimate the seepage of groundwater into the tunnels and mined reservoir. The studies included field investigations, analog computer analyses and office evaluation of the collected data and analog results. The results indicate (1) the proposed aquifer protection is feasible, (2) the recharge requirements will vary from 1.4 mgd in 1976 to 6.0 mgd in 2010, (3) seepage into the tunnels will be small, in amounts that can be easily controlled. (Knapp-USGS)
W70-00205

LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
Department of Water and Sewers, Chicago, Ill.
For primary bibliographic entry see Field 05B.
W70-00263

AMMONIA NITROGEN LOSSES FROM STREAMS,
San Diego State Coll., Calif. Dept. of Civil Engineering.
Frank E. Stratton.
J of Sanitary Engineering Div, Proceedings of American Society of Civil Engineers, Vol 94, No SA6, p 1085-1092, Dec 1968. Proc Paper No 6282. 2 fig, 4 tab, 7 ref.

Descriptors: *Ammonia, *Nitrogen cycle, *Streams, Eutrophication, Water treatment, Turbulent flow, Water pollution control, Recirculated water, Water quality, Reclamation.
Identifiers: *Ammonia-nitrogen.

The loss of ammonia gas to the atmosphere due to surface turbulence may account for a significant quantity of ammonia-nitrogen losses from streams and rivers. A recirculating flume with a simulated river bed was used to determine the ammonia loss rate constant for a synthetic river water containing dissolved ammonium. Rate constants (per hour), k, at pH8, vary with temperature according to the relationship, $k = 0.048 \exp(0.13 (T-20))$, where T is temperature (degrees Celsius). At 20 deg C, k varies with pH according to the relationship, $k = 0.080 \exp(1.57 (pH - 8.5))$. According to these data, concentration of ammonia-nitrogen would be reduced 50% in 10.8 hours and 7.4 miles at T=20, pH=8.5; in 0.6 hours and 0.4 miles at T= 30, pH= 9.5. (Jacobs-Wisconsin)
W70-00267

THE CONTROL OF WATER WEEDS.
Agricultural Research Council, Kidlington (England). Weed Research Organization.
E. C. S. Little.
Weed Research, Vol 8, No 2, p 79-105, 1968. 363 ref.

Descriptors: *Aquatic weeds, *Aquatic plants, *Aquatic weed control, Water conservation, Water control, Fertilizers, Sewage effluent, Nutrients, Lakes, Channels, Reviews, Bibliographies, Herbicides, Fish, Fresh water, Algae, Ponds, Water hyacinth, Chemical controls, Paraquat, Diquat, Sodium arsenite, Copper sulphate, Monuron, Ammonia, Dalapon, 2-4-5-T Ureas, Seeds, Proteins, Microorganisms, Fermentation, Surfactants, Floating plants, Ferns, Alligatorweed, Formulation, Emulsifiers, Soil texture, Silage, Chemicals, Ditches, Persistence, Irrigation water, Harvesting, Mechanical control, Spraying, Water levels, Mammals, Birds, Snails, Insects, Fungi, Water quality, Soil sterilants, Eutrophication, Rivers, Biocontrol, Toxicity, Drawdown, 2-4-D, Aminotriazole.
Identifiers: Triazine, Dichlobenil.

Water weeds are posing increasing problems in many countries which depend on water control for development of agricultural, power, and transport resources. The United States, besides having its share of difficulties from water weeds, is also concerned with aquatic weed impairment of increasingly popular recreational aspects of water. Heavy water-weed infestation is expected when fertile land is submerged to form lakes, or when lakes and channels become silted. This problem is accentuated in developed countries by extra plant nutrients reaching water supplies from fertilizer and sewage effluent. Author presents a comprehensive review of the world's literature on aquatic weed control since 1960, to provide a guide to research with primary attention to those plants causing problems in warm environments. The literature citations are grouped as follows: Reviews, Identification, General recommendations, Important water weeds, Chemicals used in aquatic weed control, Control techniques, Biological control, Utilization of water weeds, Toxicology of herbicides to fish, Herbicides residues, and Water and its effect. Author indicates the need for more research in biological control and utilization of water weeds which might be useful in regions without the financial resources to deal with the problem. (Simsiman-Wisconsin)
W70-00269

SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
Tennesse Valley Authority, Muscle Shoals, Ala.; and Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 02K.
W70-00282

PROBLEMS OF THE PROTECTION OF WATER IN CONNECTION WITH THE BUILDING OF WATER-POWER PLANTS (IN GERMAN),
P. Nanny.
Wasser- und Energiewirtschaft, No 8-10, p 270-274, 1959.

Descriptors: *Hydroelectric plants, *Water utilization, Water quality, Water pollution effects, Fish management, Groundwater, Vegetation effects, Climatic data, Weather modification, Electric power, Peak power, Low flow augmentation.

The building of hydraulic power stations could have negative influence on (1) water quality and self-purification of downstream section, (2) changes in fish community, (3) groundwater relations, and (4) climatic conditions and vegetation. These aspects can occur if the dam is built for increasing the water level or if the water is removed from a river basin. In the second case, the negative influence is much more important and must be treated properly taking into account the downstream load by waste waters. In this case a survey study on low flow values and waste waters purification is necessary. (Novotny-Vanderbilt)
W70-00292

INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
Algemene Kunstzijde Unie N.V. (Netherlands).
C. G. Booij.
De Ingenieur, No 51, p A749-A758, Dec 20, 1968. 18 fig, 2 ref.

Descriptors: *Economic efficiency, *Thermal pollution, *Coolants, *Power plants, Temperature control, Heat transfer, Cooling towers.
Identifiers: Process industry, Waste-heat production, The Netherlands.

The paper deals with three main aspects of the subject, reviewing waste-heat generation, and use of natural cooling waters, the influence of coolant and process temperatures respectively, on prime cost of product, and measures for reducing waste-heat production. In conjunction with these points, the various aspects of internal as well as external optimization are considered, illustrated by examples and diagrams. The waste-heat production of the Netherlands is estimated for 1966 at 45,000 M.W. A short description of the waste-heat sources is given. The increase during the last ten years of the waste-heat production in the process industry was about 23% per year and for power plants 20% per year. (Rietveld-Vanderbilt)
W70-00299

COMBINED CONDENSER COOLING SYSTEM UPS PLANT AVAILABILITY,
Tennessee Valley Authority, Knoxville.
Gordon L. Ford.
Power Engineering, Vol 71, No 1, p 40-42, Jan 1967. 3 fig.

Descriptors: Thermal pollution, Water temperature, *Cooling towers.
Identifiers: *Stream temperature, *Cooling towers, Counterflow and crossflow type towers, Paradise Steam Plant (T.V.A.).

The Paradise Steam Plant being built by T.V.A. has a cooling system which will increase the availability of the earlier two units and will end heat rejection to the river during the summer, thus meeting adequately the thermal stream pollution criterion. The operation of the earlier two units during low flow period was limited according to stream temperature. The yearly average temperatures are 57.3 F dry bulb and 52.2 F wet bulb. On this basis, the optimum condenser-tower combination was determined to be that which would provide 72 F average temperature water at a condenser flow of 715 cfs, and a cooling range of 27.5 F. Hyperbolic natural draft cooling towers were chosen because they will discharge moisture-laden air over four hundred feet above the ground, which eliminates ground fog or recirculation of air through the towers and because of the additional advantage of low maintenance and operating cost. (Upadhyaya-Vanderbilt)
W70-00300

STREAMS AND WATERS.

Ind Ann Stat sec 48-5610 (1963).

Descriptors: *Indiana, *Administrative agencies, *Rivers, *Streams, Maintenance costs, Maintenance, Bridges, Tunnels, Banks, Flow, Flow control, Obstruction to flow, Water pollution, Pollution abatement, Water pollution control, Bank protection, Banks.

The Board of Park Commissioners shall have the power to keep rivers, streams, and waterways that run through or bound park property open and free of pollutants. The Commissioners shall maintain the banks, build levees, control flow, and promulgate rules and regulations concerning said waterways. They shall construct any necessary dams, bridges, viaducts, or tunnels. They may require owners of real estate bounding on said waters to remove any pollutants from their banks or waters. The failure of property owners to comply empowers the Commissioners to remove such pollutants and to certify the cost of removal to the county treasurer who will assess the cost to the property involved. (Darragh-Florida)
W70-00381

OIL AND GAS WELLS--DECLARATION OF POLICY.
Iowa Code Ann sec 84.1 (Supp 1969).

Descriptors: *Iowa, *Surface waters, *Subsurface drainage, *Water pollution control, Legal aspects, Public benefits, Conservation, State governments, Legislation, Political aspects.

It is hereby declared that the general welfare requires that the underground and surface water of the state be protected from pollution and conserved in the best interests of the people of the state. (Heckerling-Florida)
W70-00386

OHIO RIVER VALLEY WATER SANITATION COMPACT.
Ky Rev Stat Ann sec 220.550 (1963).

Descriptors: *Kentucky, *Interstate commissions, *Water pollution control, *Interstate compacts, Legislation, Legal aspects, Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Ohio River, Water pollution, Pollution abatement, Water supply, Sewage treatment, Industrial wastes, Public health, Surveys, Watersheds (Basins), Water quality, Waste treatment, Water utilization, Standards.
Identifiers: *River valley commissions, River valleys, Interstate waters, Minimum standards.

The Ohio River Valley Water Sanitation Compact is enacted and entered into by the state. Kentucky is within the Ohio River drainage basin. Each of the party states pledges its cooperation in the control and abatement of pollution of waters common to two or more states. A sanitation district and a sanitation commission are created. Selection procedures for and the qualifications of commissioners are provided for as is the administration of the commission. The guiding principle of the compact is that pollution by sewage or industrial wastes originating with a party state shall not injuriously affect the various uses of the interstate waters. Minimum standards are set for the treatment of sewage and waste. The commission is empowered to promulgate rules and regulations for administering and enforcing the foregoing provisions. The commission will survey, study, and report on ways to reduce pollution and, in so doing, will confer with all interested agencies. The commission will draft and recommend to the governors of the signatory states uniform legislation dealing with pollution problems within the district. The commission will consult with and advise any party having particular problems connected with water pollution, particularly with regard to the construction of treatment plants. (Keith-Florida)
W70-00391

OIL, GAS, AND SALT WATER WELLS.

Ky Rev Stat Ann secs 353.150 to 353.190 (1963).

Descriptors: *Wells. *Kentucky, *Saline water intrusion, *Well regulations, Legislation, Damages, Legal aspects, Oil wells, Salts, Saline water, Regulation.

Any person in possession of any well in which oil, gas, or salt water is found shall, unless the product is used, close the well within a reasonable time. If the person in possession fails to comply, the nearest other possessor may enter and close it and recover costs from the possessor. The owner or occupant of any salt or saltpetre works shall keep the brine that is drained off enclosed so as to prevent access to it. When such works are abandoned it shall be filled up or enclosed by the owner or possessor. If these actions are not taken and injury to another's stock results, the persons under the duty to comply shall be jointly and severally liable for the damages. (Darragh-Florida)
W70-00394

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00395

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
162 NW2d 249-259 (Minn 1968).

Descriptors: *Minnesota, *Water pollution control, *Sewage, *Standards, Administration, Pollution, Stream pollution, Water quality control, Water pollution treatment, Water pollution, Effluents, Cities, Impaired water quality, Pollution abatement, Sewage effluents, Potable water, Administrative decisions, Judicial decisions, Administrative agencies, Legal aspects.

The Water Pollution Control Commission was created to investigate pollution of the waters of this state, to establish reasonable pollution standards, to make reasonable orders requiring the discontinuance of the discharge of sewage or other wastes into any waters of the state, and to issue, deny, or revoke permits for the discharge of sewage. Respondent Sewer District was created to deal with sewage problems unique to its district. Pursuant to its powers and duties, the district planned for an outfall of effluent 1.1 miles downstream from the main water intake of the city of Minneapolis. The Commission has held that the possibility of contamination due to human failures and unusual natural conditions warrants a standard prohibiting such outfall. The district argues that the possibility of contamination is so remote that the standard is unreasonable and invalid. The trial court was justified in finding the standards unreasonable and exceeding the Commission's statutory powers. The prohibition was absolute and without reference to the purity of the effluent, and it was unreasonable to accept the probability that effluent would ever reach the water intake. These standards were only invalid as applied to these facts. (McFerrin Smith-Florida)
W70-00397

SANITATION DISTRICTS.
Ky Rev Stat Ann secs 220.010-220.540 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Environmental sanitation, *Sewage districts, Sanitary engineering, Water pollution, Waste disposal, Eminent domain, Condemnation, Construction costs, Financing, Taxes, Project planning, Stream improvement, Sewers, Public health, Water pollution control, Legislation, Legal aspects.

The Commissioner of Sanitation Districts is vested with jurisdictional power and authority to establish sanitation districts within any county. Upon petition by freeholders or municipalities within a proposed sanitation district, the Commissioner may establish a sanitation district in order: (1) to prevent and correct pollution of streams; (2) to regulate the flow of streams for sanitary purposes; (3) to clean and improve stream channels; and (4) to provide for the collection and disposal of sewage and other liquid wastes. A board of directors governs the operation of each sanitation district. Each board has authority to (1) prepare plans for the construction or improvement of sanitation projects; (2) hold, encumber, and control by purchase or condemnation any real or personal property within the district; (3) contract and be contracted with; (4) levy certain annual taxes; (5) issue negotiable sanitation district bonds; and (6) do those things necessary to carry out the purposes of the district. (McDonough-Florida)
W70-00399

SANITATION DISTRICTS.
Ky Rev Stat Ann secs 220.010-220.130 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Water pollution control, *Administrative agencies, *Sewage districts, Stream improvement, Eminent domain, Condemnation, Environmental engineering, Environmental sanitation, Streams, Sewers, Laterals, Siphons, Waste disposal, Channel improvement, Legislation, Legal aspects, Liquid wastes, Cities, Local governments.

The state Director of the Division of Sanitary Engineering of the Department of Health also acts as the Commissioner of Sanitation Districts. He has the power to establish sanitation districts to prevent stream pollution, to clean streams, and to provide for the collection and disposal of sewage and liquid wastes. Sixty percent of freeholders within a proposed district or any municipality not of the first class may petition the Commissioner to establish a district. Municipalities within the proposed district may decide whether city property will be included within the district. Upon notice of the petition and a favorable investigation, the Commissioner may declare a sanitation district. Objection to the proposed district must be timely. The sanitation district is a political subdivision of the state with perpetual existence and powers: (1) to sue and be sued; (2) to contract and be contracted with; (3) to incur liabilities; (4) to exercise the right of eminent domain; (5) to assess and levy taxes; (6) to issue bonds; and (7) to do other acts to carry out the purposes of the district. The certificate establishing the district is binding on all district realty. (McDonough-Florida)
W70-00400

SANITATION DISTRICTS.
Ky Rev Stat secs 220.140-220.350 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Sewage districts, *Project planning, Environmental sanitation, Contracts, Eminent domain, Condemnation, Sanitary engineering, Water pollution, Sewage, Stream improvement, Construction, Laterals, Siphons, Bids, Operation and maintenance, Water pollution control, Legislation, Legal aspects, Regulation, Control.

A sanitation district is governed by a board of directors which has all the powers of the district and controls all the affairs and property of the district. The board has the power to: (1) adopt necessary rules and regulations for the proper management and construction of sanitation projects; (2) hire an engineer and attorney; and (3) prepare and execute plans approved by the State Board of Health for the construction and improvement of sanitation projects. After a district is established, no person or corporation may install or construct any sewage facility without the approval of the board and the state Board of Health. The board is limited to operations aimed at the construction and maintenance of projects including: (1) the improvement of any stream, watercourse, or body of water receiving sewage; (2) the construction and maintenance of laterals, trunk sewers, intercepting sewers, and other disposal works; (3) the acquisition by purchase or condemnation of any real or personal property within the district; and (4) the contracting for sanitation service for wastes produced outside the district. Installation or operation contrary to this chapter constitutes an abatable nuisance. (McDonough-Florida)
W70-00401

SANITATION DISTRICTS.
Ky Rev Stat Ann secs 220.360-220.540 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Administrative agencies, *Financing, *Sewage districts, Costs, Construction costs, Taxes, Water pollution, Sewers, Sewage disposal, Project planning, Eminent domain, Environmental sanitation, Condemnation, Sanitary engineering, Legislation, Legal aspects, Cities, Maintenance costs, Rates.
Identifiers: Annexation.

The board of directors of a sanitation district may levy up to three annual taxes to cover initial costs. The board may issue negotiable warrants and sanitation district bonds to defray costs of construction and property acquisition. The bonds are not subject to taxation and are payable solely from sanitation district income but are not to be considered debts of the district within the meaning of the state constitution. Holders of district bonds have a statutory lien on all sanitation district property. The board determines reasonable rates and compensation or rentals to be charged for the use of sanitation facilities, but all rates must be uniform within a given class of users. A district may petition the commissioner of sanitation districts to annex additional territory to the existing district. Specified sized cities having their own sanitation systems may petition to annex part of or all of an existing sanitation district. (McDonough-Florida)
W70-00402

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
Technion - Israel Inst. of Tech., Haifa. Hydraulic Lab.
For primary bibliographic entry see Field 07B.
W70-00039

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
City Univ., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-00041

A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
Geological Survey, Huron, S. Dak. Water Resources Div.
E. F. LeRoux, and D. G. Jorgensen.
Ground Water, Vol 7, No 5, p 16-18, Sept-Oct 1969. 3 p, 3 fig.

Descriptors: *Planning, *Project planning, *Critical path method, *Scheduling, Control, Timing, Water resources development.
Identifiers: Project Evaluation and Review Technique.

The techniques of network planning and scheduling are now firmly established as management tools in business and industry. By means of network diagrams showing time, phase, and cost relations, the techniques facilitate efficient scheduling and managing of projects of any size or complexity. The two most common methods of network planning and scheduling are PERT (Program Evaluation and Review Technique), which was developed by the U.S. Navy for use in the evaluation a review of development projects, and CPM (Critical Path Method), which was developed by International Business Machines and E. I. du Pont de Nemours and Co. The original versions of CPM and PERT differ in that CPM requires two time estimates, both related to cost, and PERT requires three time estimates related to probability. For planning and evaluation of water resources studies and construction projects, a simplification of the two systems requiring only one estimate (normal time) is ideally suited. (Knapp-USGS)
W70-00206

A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
Kansas State Univ., Manhattan. Inst. for Systems Design and Optimization.
For primary bibliographic entry see Field 06B.
W70-00208

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
Southern Mississippi Univ., Hattiesburg. Dept. of Economics.
For primary bibliographic entry see Field 06B.
W70-00213

A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
For primary bibliographic entry see Field 10.
W70-00306

OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
Carborundum Co., Niagara Falls, N.Y.
For primary bibliographic entry see Field 08G.
W70-00325

6B. Evaluation Process

STUDY OF WATER RESOURCES AND MANAGEMENT.

Ind Ann Stat secs 27-1701 thru 27-1709 (Supp 1968).

Descriptors: *Indiana, *Surveys, *Water rights, *Water resources, Water resources development, Water management (Applied), Water conservation, Ground water, Surface waters, Water utilization, Flood control, Pollution abatement, State jurisdiction, Legislation, Legal aspects, Planning, Projects, Federal government, Resource development, Interagency cooperation, Administrative agencies, Federal government.

A study committee is hereby appointed and directed to make a comprehensive survey and study of water rights and water management, including surface and ground waters in Indiana. The committee shall contain, among others, members representing the state flood control and water resources commission, the department of conservation, the board of health, and the pollution control board. The committee shall submit biennial reports to the legislature. State agencies are to cooperate with the committee in its efforts if requested. The state flood control and water resources commission, the board of health, and the water resources division of the department of conservation are authorized by the Water Resources Research Act of 1965 to conduct applied research in their respective areas for solution of problems involving the beneficial development, use, and management of the state's water resources. The need for additional knowlege is urgent in such areas as drainage of streams, meandering characteristics of alluvial streams, climatic effects of evaporation losses from impoundments, and mapping of the location and availability of ground water. The agencies are to report to the water resources study committee and are authorized to cooperate with other state agencies and the federal government. (Kelly-Florida)
W70-00128

OHIO RIVER AREA COORDINATING COMMISSION.
Ind Ann Stat secs 68-1301 thru 68-1304 (Supp 1968).

Descriptors: *Indiana, *Administrative agencies, *Ohio River, *Water pollution, Navigation, Flood control, Erosion control, Reforestation, Conservation, Water supply, Recreation, Pollution abatement, Interstate, Interstate rivers, Tourism, Coordination, Water pollution control Legislation, Legal aspects.

The Ohio River Area Coordinating Commission consists of representatives of named state commissions or departments, the legislature, and two universities. The Commission's purpose is to study problems and economic opportunities arising from the modernization of navigation facilities on the Ohio River. The study shall include floods, pollution control, erosion, conservation, and recreation. The Commission shall attempt to coordinate local, state, intrastate, and federal programs concerning the Ohio River area. A yearly report to the legislature is required. (McDonough-Florida)
W70-00196

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
Harza Engineering Co., Chicago, Ill. Water Resources Planning Div.; and Metropolitan Sanitary District of Greater Chicago.
For primary bibliographic entry see Field 05G.
W70-00205

A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
Geological Survey, Huron, S. Dak. Water Resources Div.
For primary bibliographic entry see Field 06A.
W70-00206

A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
Kansas State Univ., Manhattan. Inst. for Systems Design and Optimization.
L. E. Erickson, L. T. Fan, E. S. Lee, and D. L. Meyer.
Water Resources Bull, Vol 5, No 3, p 18-36, Sept 1969. 19 p, 12 fig, 1 tab, 15 ref. OWRR Project C-1032.

Descriptors: *Mathematical models, *Optimization, *Multiple-purpose reservoirs, *Reservoir operation, Recreation, Municipal water, Water supply, Hydroelectric power, Irrigation water, Flood control, Navigation, Sport fishing, Systems analysis, Dynamic programming.
Identifiers: *Pattern search.

A fairly realistic nonlinear model of a water reservoir system with multiple uses was developed based on available data, and the optimum of the system based on the developed model was determined by the combined use of dynamic programming and pattern search techniques. Both the simplex search and the Hooke and Jeeves pattern search were used. Modeling and optimization can treat complex inequality constraints. The benefits or losses resulting from urban water supply, hydroelectric power generation, irrigation, and recreation are taken into account in the profit function. Other uses such as flood control, navigation, and fish and wildlife enhancement are considered indirectly by the use of inequality constraints. It is concluded that the optimization-research approach can treat a water resource allocation problem involving complex inequality constraints. (Knapp-USGS)
W70-00208

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
Southern Mississippi Univ., Hattiesburg. Dept. of Economics.
D. C. Williams, Jr., and Donnie L. Daniel.
Water Resources Bull, Vol 5, No 3, p 50-56, Sept 1969. 7 p, 2 tab, 3 ref.

Descriptors: *Water resources development, *Project planning, *Evaluation, *Risks, *Economics, Flood control, Damages, Costs, Project life, Cost allocation, Cost-benefit analysis, Feasibility, Optimum development plans, Probability.
Identifiers: Project feasibility.

Factors that influence the acceptability of the expected-value criterion are examined in evaluating a method of handling risk or uncertainty in decision-making where damages from unusual physical occurrences such as hurricanes or floods must be considered. These factors are the project duration and the problem of obtaining accurate estimates of the probability of occurrence for different sizes of natural disasters. The problem of estimating accurate probabilities of occurrence for different sizes of natural disasters is not as great as it might appear and in most situations will not defeat the usefulness of the method. The time span during which the project is expected to exist has greater implications for the usefulness of the expected value criterion. For projects with a continual or long-term existence, the expected value approach appears highly applicable. However, it becomes less applicable for projects that are short-term in nature. The basis for distinguishing short- and long-term projects is presented. (Knapp-USGS)
W70-00213

ADMINISTRATIVE ASPECTS (OF WATER), (IN DUTCH),
Dijkgraaf van het Hoogheemraadschap van Delfland (Netherlands).
For primary bibliographic entry see Field 06D.
W70-00297

CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
William Whipple, Jr.
Jour San Eng Div, ASCE, Vol 95, Oct 1969. p 3, Discussion of Proc Paper 6005 by W C Ray and W R Walker, June 1968.

Descriptors: *Benefits, *Water quality, *Optimum development plans, Public health, Recreation, Economic decision making, Value.
Identifiers: *Water quality benefits, Recreation benefits, Home environment, Working environment.

Without economic evaluation of water quality, there is no way to determine whether or not a given water quality standard represents an optimum situation. Ray and Walker consider benefits under headings of recreation, public health and aesthetic values. Methods of evaluating recreation benefits are now fairly well developed. Public health values are apt to remain intangibles, except for low standards that are not considered among debatable alternatives in the U.S. Aesthetic benefits is too narrow a concept for remaining benefits, which include improvements in both home environment and working environment. Although, as Ray and Walker point out, FWPCA officials in the past have moved slowly in this field, the Water Resources Council has expressed a government policy in favor of evaluating water quality benefits. (Whipple-Rutgers)
W70-00313

OHIO VALLEY COMPACT.

Ind Ann Stat secs 68-912 thru 68-917 (1961).

Descriptors: *Indiana, *Ohio River, *Interstate compacts, *Water resources development, Interstate commissions, Long-term planning, Natural resources, Human resources, Conservation, Resource development, Rivers, River systems, Legislation, Water utilization, Water resources, Planning.

The Ohio Valley Interstate Commission is hereby created to promote comprehensive planning for the optimal use of the Ohio River Valley's human and natural resources. The term 'Ohio Valley' means the Ohio River, its tributaries and all land drained by said river and tributaries, to the extent that they lie within the party states. Each party state may have seven commissioners. The commission shall have the power to: (a) promote the balanced development of the valley by certain procedures of recommendation and publication; (b) recommend integrated plans and programs for the conservation, development, and proper utilization of the water, land, and related natural resources of the Ohio Valley; (c) secure the necessary research and developmental activities; (d) make recommendations for appropriate action to the party states and the federal government. (Smith-Florida)
W70-00380

RECENT DEVELOPMENTS IN FISHING METHODS AND EFFECTS OF MANAGEMENT ON EFFICIENCY,
Dayton L. Alverson.
In Biological and Economic Aspects of Fisheries Management, College of Fisheries and the Department of Economics of the University of Washington at Seattle, p 142-147, Feb 17-19, 1959. 7 p.

Descriptors: *Management, *Fisheries, Salmon, Competition, Regulation, Trawling, Technology, Fish management, Fish attractants, Fish conservation, Productivity.
Identifiers: *Economic growth, Shrimp, Cod trawlers.

Fishing is one aspect of water resources which has experienced a large growth in technology since the end of World War II. The author gives the causes of this growth and some of the improvements resulting from it. The effect of these improvements is studied with special emphasis on the deficiencies of the United States in this area. Regulations in the area have not been what might have been hoped for and have been detrimental to the fishing industry in many situations. Management of ocean fisheries has been wrong in attempting to control production by controlling efficiency. The international position of world fisheries is in a very competitive status and inefficiency cannot be tolerated. (Murphy-Rutgers)
W70-00413

ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
Economic Development Administration, Washington, D.C.; and Vermont Univ., Burlington.
Harvey A. Garn, and Gene Laber.
In Planning 1968, Selected Papers from the ASPO National Planning Conference, San Francisco, p 262-270, May 4-9, 1968. 9 p, 10 ref.

Descriptors: *Conservation, *Environment, Economic impact, Industrial production, Income, Water pollution, Fishing, Costs, Deterioration, Social values, Income analysis.
Identifiers: *Social accounting system, Market system, Income distribution, Social benefits, Social costs.

The article argues from the premise that in order to achieve over-all increases in per capita income, some natural resources, including, of course, water resources, must be expended. It stresses the need in general for a full social accounting system for intelligent decision-making with explicit recognition of possible distribution objectives. It also deals specifically with the special circumstances which surround the question of resource use in low-income regions. The social accounting system is needed especially to deal with the classic externality problems encountered as well as some complex income distribution implications. In addition, many of the outputs lack market values. Some interesting suggestions are also made for the use of natural resources in low-income regions as an integral part of the larger topic of resource allocation stressed here. Water resources planning is concerned with most of the same problems. (Murphy-Rutgers)

W70-00414

FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
Georgia State Coll., Atlanta, Ga. School of Business Administration.
James E. Hibdon.
Southern Economic Journal Vol XXV, No 1, p 48-63, July 1958. 16 p.

Descriptors: *Flood control, Economic evaluation, Taxes, Government, Economic analysis, Benefits, Economic justification, Costs, Dam, Statistics, Flood damage, Flood plain, Welfare economics, Pricing, Indirect benefits.
Identifiers: *TVA, *Flood losses, *Land value.

The author raises questions concerning the accuracy of the flood control benefits provided by the TVA. Flaws are demonstrated to exist in the assumptions on which the estimates were based and indicate that the estimates are exaggerated. The flood control program may be justified economically but proof of the justification would require a better determination of the value created as well as a test of its adequacy relative to the costs. The author also questions the subsidy which accrues to bondholders who gain the benefits of increased productivity but do not pay the costs of flood control. The application of a levy against land as a feasible means of exacting payment from beneficiaries of flood control programs is proposed. (Murphy-Rutgers)
W70-00416

6D. Water Demand

WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
J. A. Johnson.
J Soil Water Cons, Vol 14, No 1, p 3-6, Jan 1959. 4 p.

Descriptors: *Water policy, *Water rights, *Water users, *Southeast U. S., Legislation, Reasonable use, Public benefits, State governments, Judicial decisions, Legal aspects, Water law, Political aspects, Riparian rights, Planning, Storage, Beneficial use, Water demand, Water resources, Water allocation (Policy), Water demand.

Eastern states are taking a new look at water problems and water-rights policies. State legislatures and water-user organizations are attempting to educate the public to these problems. Studies have been instituted in an attempt to evolve water policies which will meet modern needs. Water policy may be defined by the legislature in one broad act and usually goes as far as the people are ready to act. Water policy, to be fully effective, must be acceptable to the people or users to which it applies. In years past water-rights policies and laws were for the most part court-made. Water users wanting more adequate protection for their investments and more specific rights of use pushed for a change in water policy. Formal action began in the early 1950's in the Southeast. The direction of change has been toward beneficial use, conservation of supplies, encouragement of seasonal storage, and restrictions upon waste and unreasonable methods of use. Southeastern states have adopted in their new laws one or more aspects of the western system. An example is the general declaration of reasonable beneficial use found in a number of eastern statutes. The water-use needs and water problems of this entire section of the country have changed materially in recent years. Such adjustments as prove necessary can be made with benefit of a vast background of experience existing in all states. (Heckerling-Florida)
W70-00085

WATER RIGHTS AND OUR EXPANDING ECONOMY,
C. E. Busby.
J Soil and Water Cons, Vol 9, No 1, p 65-69, Jan 1954. 5 p.

Descriptors: *Water rights, *Water utilization, *Water law, *Water resources development, Reasonable use, Prior appropriation, Riparian rights, Administration, Water demand, Water management (Applied), Water conservation, Water allocation (Policy), Water consumption, Judicial decisions, Damages, Legal aspects, Groundwater, Water supply, Water conservation.

Recently some states have experienced a considerable expansion in water use by agriculture, industry, towns, and cities. As a result, competition and conflicts have arisen, especially during periods of great water demand and limited water supply. These conflicts of interest over water are not new. The system of water rights and administration in the eastern states is very different from that in western states where life is directly or indirectly dependent on water. These systems differ in three basic areas: (1) the emphasis placed upon beneficial use and conservation of water, (2) the emphasis placed upon security for and encouragement of investments in water development and use, and (3) the emphasis placed on statewide and local administrative responsibility for guiding water development and use. All three policies are emphasized in the West, but not in the East. Some of the most vital questions of policy which need examination are: (1) the use and damage aspects of water, (2) water law and administration in general, (3) rights to water in the air, and (4) rights to water on the ground. The present water law found in the East was developed by the courts over one hundred years ago and is in need of modification along lines consistent with present water and related land capabilities. (Heckerling-Florida)
W70-00088

A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
Harv J Legis, Vol 4, No 3, p 399-419, Jun 1967. 21 p, 70 ref.

Descriptors: *Legislation, *Administrative agencies, *Water resources development, *Future planning, Administration, Decision making, Riparian rights, Prior appropriation, Optimum development plans, Resource allocation, State governments, Water allocation policy, Water users, Permits, Water policy, Water resources, Water supply.
Identifiers: *Equitable water distribution.

This article proposes a statute to deal with the imminent water shortage facing the eastern half of the United States. Citing the inefficiency of both the riparian and prior appropriation theories, the article proposes an administrative system. A discussion of the background and perspective of the proposed statute, including constitutional problems, precedes the body of the statute. The statute contains eight articles. Article one contains definitions of terms. Article two sets forth a declaration of policy and standards which calls for the development, utilization, and control of all water resources to effectuate the maximum public benefit. Articles three and four establish a Water Resources Board with jurisdiction over all water resources in the state. A broad variety of powers and duties, consistent with the purposes of this legislation, are detailed. Article five requires permits for the use of water. A detailed system to insure that all water is distributed equitably and beneficially is provided, and procedures for applications, hearings, fees, and judicial review are outlined. (Schram-Florida)
W70-00184

WATER LEGISLATION,
Edward Hamming.
Economic Geography, Vol 34, No 1, p 42-46, Jan 1958. 5 p, 11 ref.

Descriptors: *Legislation, *Water law, *Water utilization, *Riparian rights, Reasonable use, Prior appropriation, Surface waters, Percolating water, Land tenure, United States, Water rights, Groundwater, Legal aspects, Water demand State governments, Water resources, Overlying proprietor, Public rights, Flow, Water supply.

With the demand for water in the United States constantly increasing there is a need for state regulations defining and delimiting the rights of individuals and corporations in utilizing this resource. There are two basic doctrines of water use: the riparian or common law rule and the prior appropriation doctrine. The fundamental differences between the two doctrines have caused a long history of litigation and have brought about drastic modifications in water rights legislation. The riparian doctrine applies to both surface and underground waters. In the former case it is aimed at maintaining an unrestricted flow of water in surface streams; in the latter case the owner of the overlying land has the absolute ownership of percolating water existing in his land. Recent trends put groundwater on the reasonable use basis or apply the same principles of use and administration to groundwater as are applicable to surface waters. The trend is toward appropriation, which calls for effective public control. Any change in water legislation must be based on scientific research, for efficient utilization of the water supply may be had under either the riparian or appropriation doctrines, provided the governing principles are well defined and applied. (Heckerling-Florida)
W70-00185

ADMINISTRATIVE ASPECTS (OF WATER), (IN DUTCH),
Dijkgraaf van het Hoogheemraadschap van Delfland (Netherlands).
J. P. Winsemius.
De Ingenieur, p A 762-764, Dec 20, 1968.

Descriptors: *Water resources development, *Administration, Water allocation, Local government.

The problem of the scarcity of water is, on a national scale, not an unfavorable overall balance position, but a liquidity problem. Usually the quantity of water should be sufficient if carefully controlled and distributed on a national and regional level. Firstly, this management will have to be one of the bases of the overall national planning and the annexed regional planning especially in relation to (1) industrial activity and (2) the location of power plants. Secondly, management of surface- and groundwater should be closely co-ordinated and in most cases even integrated. Thirdly, this co-ordinated management should balance all interests concerned and should have means at its disposal in order to compensate interested parts. Finally, a strongly co-ordinated management will have to curtail the historically grown autonomy of boards on lower level, either by reorganizing their tasks in the framework of the new national structure, or by winding up these boards and transferring their tasks. (Sherman-Vanderbilt)
W70-00297

RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
Bureau of Water Hygiene, Cincinnati, Ohio.
J. Keith Carswell, James M. Symons, and Gordon G. Robeck.
J Amer Water Works Ass, Vol 61, No 6, p 297-304, June 1969. 8 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Domestic water, *Water pollution, *Water supply, Water pollution control, *Municipal water, *Recreation, Swimming, Boating, Fishing, Potable water, Aesthetics, Public health, Bacteria, Coliforms, Streptococcus, Water quality, Water treatment.
Identifiers: Public Health Service, Bacteria control, Virology.

Public pressure for water-based outdoor recreation is growing in the United States. Because of heightened interest, increasing attention is being given to the possibility of using public water supply sources for recreation. Five studies were made in various locations to determine the impact of water-based recreation on water quality. These studies indicated that little or no deterioration in bacterial water quality occurs at the water supply intake when recreation is permitted in or around public

water supplies. In cases where some rise in indicator organism density occurred, it was localized within the high recreational use areas and the bacterial content at the water supply intake was within the limits that permit removal by existing water treatment technology. Problems of aesthetics and loss of control of utility property, and concern over a slight deteriorating trend in water quality will probably make the decision a local matter, causing utilities to proceed cautiously in opening their reservoirs for recreation. (USBR)
W70-00348

6E. Water Law and Institutions

DRAINS AND LEVEES AFFECTING HIGHWAYS.
For primary bibliographic entry see Field 04C.
W70-00011

MCCUE V CARLTON (TITLE TO ACCRETIONS).

399 Ill 11, 76 NE2d 435-438 (1947).

Descriptors: *Illinois, *Accretion (Legal aspects), *Boundaries (Property), *Riparian land, Judicial decisions, Bank erosion, Erosion, Avulsion, Boundary disputes, Sedimentation, Stream erosion, High water mark, Riparian rights, Rivers, River beds, Water law, Streams, Legal aspects, Land forming.
Identifiers: Adverse possession.

Plaintiff owned land on a river, the deed to which granted title to the shoreline of the river. Defendant owned land adjacent to plaintiff. Defendant's deed excluded title to any land lying below the highest high water mark. Both parties claimed title to land formed by accretion and by recession of the river on one side. They both claimed by adverse possession. Plaintiff brought an action to confirm title and to enjoin trespassing by the defendant. The court held title to be in plaintiff. Accretions to riparian land held under a claim of adverse possession or by color of title go with the land to which they are attached. To acquire land formed by accretion there must be a natural and actual continuity to the land of the riparian owner. Defendant's land, because of the exception in his deed, was not riparian, and he could have no title in accretions. The court found that the evidence confirmed that title to the accretion was in plaintiff by adverse possession. (Helwig-Florida)
W70-00061

EMINENT DOMAIN AND WATER LAW,
Richard S. Harnsberger.
Neb L Rev, Vol 48, No 2, p 325-455, Jan 1969. 131 p.

Descriptors: *Eminent domain, *Water law, *Condemnation, *Compensation, Legislation, Legal aspects, Public benefits, Highways, Water policy, Water resources development, Damages, United States, Riparian rights, Navigable waters, Cities, Water supply, Regulation, Judicial decisions, Water allocation (Policy), Watercourses (Legal), Condemnation value, Dams, Streamflow, Multiple-purpose projects.

The doctrine of eminent domain has played a unique role in the attainment of social and economic goals in the United States because it permits property to be taken rather easily from private persons for public uses and purposes. Today condemnation procedures are particularly significant tools in urban renewal projects, municipal and state expressways, national interstate and defense highways, multipurpose water development undertakings, sewerage, and flood control works. One of the most troublesome legal questions growing out of the eminent domain doctrine is whether the government should be required to pay compensation for particular property taken or damaged by this action. This article examines that question generally and in the context of selected situations in water development and allocation. (See W70-00071 thru W70-00082). (Heckerling-Florida)
W70-00070

THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 327-342, Jan 1969. 16 p.

Descriptors: *Eminent domain, *Public rights, *Damages, *Compensation, Federal government, Adjudication procedure, Judicial decisions, State governments, Construction, Condemnation, Legal aspects, Land tenure.
Identifiers: Reserved rights, Sovereignty.

The power of both state and federal governments to acquire private property for a public or a semipublic use is well recognized and is theoretically explained as either a 'reserved right' or a power inherent in 'sovereignty'. Under the 'reserved right' theory, the state is the presumed original owner of all property and subsequent private ownership is deemed subject to the prerogative of the sovereign to resume possession whenever the best interests of society require. By definition the sovereign power of eminent domain applies only to a taking for a public use and does not exist if the proposed use is private. Any private use is therefore without either sovereign or constitutional authority. The concept of public use is given a broad definition in eminent domain proceedings. As distinguished from public purpose, the extent of public necessity for the construction and location of an improvement is a legislative question and not subject to judicial review. In addition to prohibiting the taking of property for private purposes, the due process clause of the Constitution requires that eminent domain, as an exclusively legislative prerogative, be authorized by action of the legislature. The due process clause imposes safeguards in favor of the property owner including just compensation and trial by jury. (See also W70-00070). (Heckerling-Florida)
W70-00071

EMINENT DOMAIN AND POLICE POWER,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 342-354, Jan 1969. 13 p.

Descriptors: *Eminent domain, *Compensation, *Public benefits, *Land tenure, Legal aspects, Judicial decisions, Condemnation value, Damages, Standards, Regulation.
Identifiers: *Police powers.

The general concepts governing eminent domain and the police powers cut across many types of decisions and become significant when determining whether compensation is payable. When private property is taken for public use under the power of eminent domain, the owner is entitled to receive just compensation. Conversely, if a restriction upon the utilization of property is merely a proper exercise of the government's police power, no compensation is due. Compensation is payable whenever an owner is physically dispossessed, but only consequential damages occur where there is no dispossession. This test fails to demonstrate the method of reasoning and merely places the problem in terms which are no more helpful and only one step removed from the primary terms, police power, and eminent domain. It has come to be recognized that there is only a difference in degree between non-compensable damage to a property owner under the police power and a deprivation of property rights under the power of eminent domain. Some authorities take the position that no compensation is payable where a regulation forces an owner to bear the external costs or burdens of his private activities, but that compensation should be paid when benefits accrue to the community. (See also W70-00070). (Heckerling-Florida)
W70-00072

PRIVATE UNDERTAKINGS AS PUBLIC USES,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 354-366, Jan 1969. 13 p.

Descriptors: *Eminent domain, *Public benefits, *Water utilization, *Judicial decisions, Legislation, Riparian rights, Local governments, Jurisdiction, Condemnation.
Identifiers: Constitutions.

Theoretically, property taken by eminent domain should be put strictly to public use. Even though a legislature approves a project as a public one, the ultimate decision as to whether the use is in fact public, rests with the courts. There is no exact definition of the term 'public use', and most courts make no effort to formulate one. Water is so important in arid states that many constitutions have provisions for its utilization. Constitutional provisions take several different forms. In the western states, the existence of water preference provisions may also affect the right of eminent domain. Generally, preference provisions manifest a policy to favor certain uses of water and are enacted as either constitutional or statutory provisions. Several western states allow a private person to exercise eminent domain to acquire property for his own exclusive use. Since public needs obviously must be determined in relation to environment, local conditions are an important factor in any jurisdiction which considers public benefit or advantage in determining whether private utilization of condemned property is for a 'public use'. (See also W70-00070). (Heckerling-Florida)
W70-00073

MUNICIPAL WATER SUPPLIES,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 366-377, Jan 1969. 12 p.

Descriptors: *Eminent domain, *Cities, *Municipal water, *Riparian rights, Judicial decisions, Compensation, Condemnation value, Riparian land, Public benefits, Damages, Natural flow doctrine, Reasonable use, Jurisdiction, Land tenure, Value, Water supply, Diversion.

Towns and cities are everywhere empowered by either statute or state constitution to condemn private water rights to secure water for public or domestic uses, and this effectively gives them a preference to use water on condition that the owners are compensated. The amount a municipality must pay when condemning water rights depends upon local water law. The 'natural flow' riparian doctrine is extremely wasteful in that it gives every riparian owner the right to have stream waters flow uselessly into the sea. It has been replaced in many jurisdictions by a 'reasonable use' riparian doctrine. The reasonable use doctrine allows riparian owners to divert such water as they may reasonably use to satisfy the natural demands for water upon their riparian property. The usual measure of damages under the riparian doctrine for the taking of water is the depreciation in value of the riparian land. When a municipality condemns property to obtain a new source of water supply, a problem arises as to how the landowner should be compensated. Should he be compensated according to the market value of his land or according to the value to the municipality. The courts are divided on this question. (See also W70-00070). (Heckerling-Florida)
W70-00074

CONDEMNATION FOR PUBLIC PROGRAMS,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 377-388, Jan 1969. 12 p.

Descriptors: *Eminent domain, *Condemnation, *Public benefits, *Federal government, Judicial decisions, Watercourses (Legal), Riparian rights, State governments, Streamflow, Beds, Beds under water, Navigable waters, Navigation, Docks, Bridges, Compensation, Flood control.
Identifiers: Navigational servitude.

Controlling floods, canalizing channels, developing watersheds and river basins, and stabilizing watercourses for downstream purposes are programs primarily undertaken by the federal government. States have not entered into these areas to any significant degree. One of the most important delegated powers of the federal government relating to water is the commerce clause. A watercourse is subject to the power of Congress if navigable in its natural condition. Riparian owners have a number of special rights which are recognized by state laws as being inseparably connected to the land. Just compensation is due when they are taken for public uses. Activities by riparian proprietors and the United States frequently interfere with uses the other wants to make of the stream flow or the beds. Under a number of court decisions, a riparian owner's rights are qualified by the federal navigation servitude whenever his property is located in the bed of a stream below high water level. He is entitled to no compensation for distruction of: a submerged bed, access to water, wharves and other structures, bridges over the watercourse, or rights in the flow of the water. (See also W70-00070). (Heckerling-Florida)
W70-00075

THE 'RIVER' CASES,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 388-410, Jan 1969. 23 p.

Descriptors: *Eminent domain, *Judicial decisions, *Federal government, *Condemnation, Compensation, Alteration of flow, Diversion, Water level fluctuations, Water rights, Land tenure, Water law, Flood control.
Identifiers: *Inverse condemnation.

The liability of the government for artificially changing the level of the water and for backing up or changing the direction of flow has been considered in numerous cases in the period from 1871 to 1950. These cases arose chiefly from governmental flood control activities. Physical seizure of water rights by the United States may be accomplished by either a physical invasion of land or an upstream interference with the water flow. The ability of the United States to appropriate property by physical seizure, rather than by direct condemnation, has produced many major decisions in eminent domain law. Injunctive relief is rarely granted. The 'river' cases are important precedents for determining what kinds of property rights may be successfully asserted in seeking compensation for condemnation against the United States. Supreme Court decisions are persuasive authority in state courts. (See also W70-00070). (Heckerling-Florida)
W70-00076

PROBLEMS OF VALUATION AND THE MILLER RULE,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 410-415, Jan 1969. 6 p.

Descriptors: *Eminent domain, *Condemnation value, *United States, *Compensation, Judicial decisions, Land use, Condemnation, Reclamation, Projects, Value.

Many complex problems arise in attempting to define and measure just compensation, and opinions differ over the proper methods to be used in establishing the value of the property taken. The almost universally accepted formula is fair market value of the property at the time of the taking. Potential utilization of the property by the owner is a relevant factor, but special value to the condemnor may not be made a part of the award. Large public works such as reclamation projects often involve hundreds of thousands of acres of land. To protect the government from paying for the increased value resulting from its own activities, the so-called Miller rule specified that if property is 'probably within' the scope of the project from the time the government is committed to the undertaking, even though ultimately it might not be taken, any increase in value due to the project is excluded. (See also W70-00070). (Heckerling-Florida)
W70-00077

THE 'POSSIBILITY OF COMBINATION' RULE; EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 415-422, Jan 1969. 8 p, 19 ref.

Descriptors: *Eminent domain, *Federal Power Act, *Riparian rights, *Compensation, Judicial decisions, Federal government, State governments, Condemnation value, Land use, Navigable waters, Legal aspects.

The majority of the decisions reveal that private owners have been confronted with a number of legal hurdles in their efforts to obtain compensation from the government. Generally, the rule is that if the property under consideration must be consolidated with other properties to make it suitable for a special use, such special use cannot be considered in the valuation unless the possibility of affecting the necessary combination is so likely that market value is affected. Under the Federal Water Power Act rights under state law to use the water of a navigable stream are not abolished. When the United States delegates its power by granting a license under the Federal Water Power Act, the license must pay for damage to private riparian rights even though the riparians would have been unable to recover from the federal government for the same harm. (Heckerling-Florida)
W70-00078

NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 422-434, Jan 1969. 13 p, 36 ref.

Descriptors: *Eminent domain, *Condemnation value, *Compensation, *Navigable waters, Judicial decisions, Federal government, Streamflow, Regulation, Riparian rights, Legislation, Navigation, Flood control, Watercourses (Legal), Legal aspects, Water law.

When the United States exercises its navigation easement, riparian lands on a navigable watercourse can gain no value from possible uses of the water which an owner might have made. An owner is not entitled to compensation for location values attributable to uses, actual or potential, which are dependent upon use of the water or access to it. Federal statutes provide that when land is taken for a river improvement, compensation is to be reduced by any special and direct benefits conferred by the project upon the owner's remaining land. No rights attach to the flow of a non-navigable tributary when Congress exercises its power to control floods in aid of navigation on a navigable main stream. Riparians on both navigable and non-navigable streams hold their property subservient to the power of Congress to regulate and improve navigable waters of the United States. The power is applied when Congress specifies the waters which it believes are necessary in aid of navigation. The Supreme Court has denied compensation for the value of riparian lands attributable to the flow of a navigable watercourse. (Heckerling-Florida)
W70-00079

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
Richard S. Harnsberger.
IN Eminent domain and water law. Neb L Rev, Vol 48, No 2, p 434-435, Jan 1969. 2 p, 11 ref.

Descriptors: *Eminent domain, *Judicial decisions, *Federal government, *Compensation, Condemnation value, Navigable waters, Non-navigable waters, Navigation, Water levels, Riparian land, Tributaries, Watercourses (Legal).
Identifiers: *Servitudes.

In reviewing the servitude cases several important factors stand out. First, the servitude is not co-extensive with the power of the United States over the country's watercourses under the commerce clause. The navigation power today extends to watercourses navigable in fact, those which are non-navigable but can be made navigable by artificial improvements at a reasonable cost, and non-navigable tributaries. Second, recovery against the Government is more likely if the level of the water in the watercourse is raised. Third, there have been few recoveries against the Government between 1871, when compensation was awarded for flooding riparian uplands and 1950, when recovery was permitted for the backing up of a non-navigable tributary onto riparian property. Fourth, the principal compensable situation arises when work done by the United States for improvement of navigation causes water to permanently overflow lands above ordinary high water mark. Fifth, the Government incurs no liability for activities in aid of navigation when these are carried on between the ordinary high water marks of navigable stream beds; but when the Government exercises its power over navigable streams and thereby causes interference or injuries to private property on non-navigable tributaries, compensation is payable. (Heckerling-Florida)
W70-00080

THE SERVITUDE DOCTRINE; THE DOCTRINE UNDER ENGLISH LAW,
Richard S. Harnsberger.
IN Eminent Domain and Water Law, Neb L Rev, Vol 48, No 2, p 436-442, Jan 1969. 7 p, 25 ref.

Descriptors: *Eminent domain, *Navigable waters, *Federal government, *Public rights, Judicial decisions, Compensation, Water law, Legal aspects, Riparian land, Non-navigable waters, Federal jurisdiction, Fishing, Tidal waters.
Identifiers: Servitude doctrine, Commerce, Common law.

Awarding compensation to riparians on non-navigable streams for damages when water in the main channel is lawfully raised to improve navigation relieves them from bearing part of the cost of the federal project. A review of decisions leads to the conclusion that the Supreme Court is not confident about how the servitude doctrine became the 'raison d'etre' of plenary federal power over the nation's watercourses. It has been stated the the source of the power arises from: (1) the commerce clause of the Constitution; (2) the fact that persons acquiring property on navigable streams have had 'ample notice over the years that such property is subject to a dominant public interest'; and (3) the common law of England. A comparison between the servitude doctrine and the English law gives persuasive weight to the conviction that the doctrine has its roots in antiquity. Under English law the King controlled navigable watercourses and treated then as his own. English waters later became classified either as public or as private. Fishing and navigation rights existed in connection with English waters and the submerged beds. Crown rights in tidal waters could be conveyed only with the permission of Parliament. (Heckerling-Florida)
W70-00081

THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS; STATUS OF STATE CREATED RIGHTS,
Richard S. Harnsberger.
IN Eminent Domain and Water Law. Neb L Rev, Vol 48, No 2, p 442-455, Jan 1969. 14 p.

Descriptors: *Eminent domain, *Public rights, *State jurisdiction, *Navigable waters, Navigation, Federal government, Judicial decisions, Water-

courses (Legal), Compensation, Irrigation, Consumptive use, Water law, Legal aspects, Tidal waters.
Identifiers: *Navigational servitude.

A public right to navigate was recognized in the American Colonies. After adoption of the Constitution, the federal government became the preserver of the privilege of free passage. The United States Supreme Court made certain basic modifications of the common law to accommodate the conditions and topography of the country, but the concept continued that waters navigable in fact were public as to use. At the state level, power may be exercised either under the doctrine that the ownership of water is held in trust for the people or under the doctrine of navigational servitude. A subcommittee of the American Bar Association reported that the servitude doctrine has inhibited the development of waterfront areas over navigable waters by private enterprise. Another important problem relates to the effect of the servitude upon diversions for irrigation, municipal supplies, and other consumptive uses. Congress may exercise less than its entire power and in the past has frequently recognized state law. In recent years, numerous efforts have been made to subject the federal government to state water law. In view of the plenary power of the United States, the matter of compensability is almost entirely a matter of Congressional policy. (See also W70-00070). (Heckerling-Florida)
W70-00082

RIPARIAN RIGHTS - REASONABLE USE THEORY.
For primary bibliographic entry see Field 04A.
W70-00083

NAVIGATIONAL SERVITUDE: AN OLD CONCEPT WITH A NEW LIMITATION,
For primary bibliographic entry see Field 04A.
W70-00084

WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
For primary bibliographic entry see Field 06D.
W70-00085

POLLUTION CONTROL AMENDMENTS URGED.
For primary bibliographic entry see Field 05G.
W70-00086

OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.
For primary bibliographic entry see Field 04D.
W70-00087

WATER RIGHTS AND OUR EXPANDING ECONOMY,
For primary bibliographic entry see Field 06D.
W70-00088

ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.
For primary bibliographic entry see Field 04A.
W70-00089

A NEW METHOD OF IRRIGATION,
For primary bibliographic entry see Field 03F.
W70-00090

WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.
For primary bibliographic entry see Field 04C.
W70-00091

EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.
For primary bibliographic entry see Field 04A.
W70-00092

POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
For primary bibliographic entry see Field 05G.
W70-00093

HIGHWAYS, BRIDGES, AND FERRIES-PROVISIONS FOR PARTICULAR COUNTIES.

SC Code Ann secs 33-1467, 33-1469, 33-1485, 33-1705, 33-1711, 33-1741, 33-1758, 33-1783 (1962).

Descriptors: *South Carolina, *Highways, *Bridges, *Local governments, Road construction, Right-of-way, Legislation, Manpower, Engineering personnel, Labor, Personnel, Rivers, Culverts, Regulations, Bridge construction, Bridge design, Transportation, State governments, Civil engineering, Costs, Financing, Legal aspects.

The governing body of Charleston County may sell any rights-of-way, roads, or bridges standing in the name of the county. Such governing body may pass regulations to prevent improper drainage pipes from being placed along county roads and shall insure adequate drainage along all county roads. The bridge fund of Cherokee County shall be expended in maintenance of bridges and culverts in various townships. The governing body of Hampton County shall not let by contract the construction or repair of any bridge which can be done by a chain-gang force. Anyone operating a vehicle who damages a bridge in Horry County shall report the fact immediately or be subject to a fine. The governing body of Lancaster County shall have authority over all highways and bridges and may construct new ones as needed. The county shall, by the chain-gang or other means, keep all highways and bridges in proper repair. One mill of the 5 mill levy on property shall be for the construction of permanent bridges which shall be constructed of reinforced concrete or steel. No one shall close a road, bridge, or ferry in Lexington County without the permission of the governing body. (Helwig-Florida)
W70-00094

LOMBARD PARK DIST V CHICAGO TITLE AND TRUST CO (AUTHORITY TO MAP FLOOD PLAIN ZONING).
IN Eminent Domain and Water Law. 245 NE2d 298-303 (Ill App Ct 1969).

Descriptors: *Illinois, *Flood plain zoning, *Geologic mapping, *Condemnation value, Judicial decisions, Zoning, Regulation, Flood plains, Geomorphology, Building codes, Legal aspects, Mapping, Contours, Maps, Data collections, Surveys, Condemnation, Eminent domain, Compensation.

In a condemnation proceeding, a map was introduced to show that the property in question was in a flood plain area where residences could not be built. The map was admitted as an official public document and an exception to the hearsay rule. Generally, public records come within the exception if required either by statute or authorized to be maintained by the nature of the office, and if they concern matters to which the official charged with preparation could testify if called as a witness. The map in question was a study of a wide array of hydrologic data to evaluate the depth and frequency of flooding and was prepared by the U. S. Geological Survey. The court held that admission of the map was prejudicial to the judgment and reversible error. There was no showing of statutory authority to determine flood plains nor was it incidental to examining geological structure and mineral resources. The legend on the map did not include the property in question within the plain of overflow, nor was the data proven to be sufficiently reliable or such that the preparing official could have testified as to its nature. (Douberley-Florida)
W70-00095

UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
409 F2d 961-963 (4th Cir 1969).

Descriptors: *Navigable waters, *Damages, *Federal government, *Remedies, Judicial decisions, Legal aspects, Maryland, Legislation, Navigation, Harbors, Docks, Costs, United States.
Identifiers: *Drydocks, Obstruction of navigation.

In calm seas and clear weather defendant's floating drydock took on water and foundered while under tow. The wreck obstructed navigation, and the United States took action to recover cost of removal from the owner and towing company. The district court found for the United States on grounds that the drydock was not a 'vessel' or 'craft' under the scope of 33 USCA section 409, which relieves the owner of liability unless the sinking is intentional, and held that the owner was responsible for removal. This court reversed, holding the drydock to be within the meaning of section 409. On appeal, the Supreme Court found that in addition to the in rem rights conferred by section 409, the United States had a right in personam to recover for removal of a vessel negligently sunk and remanded the case to consider this aspect. The court here remanded the case to hear evidence relevant to the negligence issue and to make new findings. Because of the then existing interpretation of section 409, the negligence issue had not been adequately considered by the district court in its initial determination. (Douberley-Florida)
W70-00096

IOWA NATURAL RESOURCES COUNCIL V MAPES (INJUNCTIVE ABATEMENT OF AN UNAUTHORIZED STREAM OBSTRUCTION).

164 NW2d 177-180 (Iowa 1969).

Descriptors: *Iowa, *Streamflow, *Natural flow, *Obstruction to flow, Channel flow, River flow, Channels, Diversion, Dams, Levees, Routing, Streams, Water law, Administrative agencies, Abatement, Flow control, Riparian rights, Riparian land, Legislation, Civil engineering, Judicial decisions, Legal aspects.
Identifiers: Injunction (Mandatory), Nuisance.

Defendants, riparian owners, built a dam which together with a new channel straightened a branch of a river flowing through their property. They did the construction without making the necessary statutory application. Plaintiff Iowa Natural Resources Council sought a mandatory injunction prohibiting defendants from maintaining the obstruction on the basis that the requisite permission had not been obtained for the dam's construction. The trial court dismissed the action. The supreme court affirmed, holding that the Council failed to establish the necessary statutory nuisance so as to entitle it to relief by injunctive abatement. Failure to comply with the statute requiring permission to construct a dam will not per se require injunctive abatement without a clear showing of a nuisance or other situation that requires an injunction. (Helwig-Florida)
W70-00097

STATE PLANNING.

Ark Stat Ann sec 9-319 (Supp 1967).

Descriptors: *Arkansas, *Planning, *Administrative agencies, *Recreation facilities, Developed

waters, Legislation, Operation and maintenance, Parks, Water supply, Recreation.
Identifiers: Water acquisition.

The Arkansas Planning Commission is authorized to initiate and maintain a comprehensive plan for development of the outdoor recreation resources of the state. As an adjunct to the above plan, the Arkansas Publicity and Parks Commission is authorized to develop, operate, and maintain outdoor recreation areas and facilities and to acquire waters interest in waters for such areas and facilities. (Holt-Florida)
W70-00098

BOERNER V MCCALLISTER (NAVIGABLE STREAMS).

197 Va 169, 89 SE2d 23-28 (1955).

Descriptors: *Virginia, *Navigable rivers, *Ownership of beds, Judicial decisions, Boundaries (Property), Navigable waters, Rivers, Streams, Riverbeds, Navigation, Non-navigable waters, Riparian rights, Streambeds, Water law, Fishing, Saw log test.
Identifiers: Trespass, Navigable in fact, Injunctions (Prohibitory).

Defendant trespassed on plaintiff's land to fish in a non-navigable stream. Plaintiff's title to the land was originally granted by the crown and included title to the stream bed, there being no law at the time to prevent the conveyance of river beds. Plaintiff sought to enjoin defendant from trespassing and from fishing in the river. Defendant contended that the river was navigable in fact and open to public use. Beds of non-navigable streams are owned by the riparian owner. The question of navigability is factual. The test being whether the stream is susceptible of being used as a highway for commerce. The burden of proving navigability is upon the one asserting such. The court held that a showing of one unsuccessful effort to float logs during a flood did not carry the burden of proof. The landowner was held to be entitled to a permanent injunction. (Helwig-Florida)
W70-00099

MISSISSIPPI RIVER PARKWAY.

Ark Stat Ann sec 76-1806 (1958).

Descriptors: *Arkansas, *Land, *Right-of-way, United States, Bridges, Bridge construction, Legislation, Administrative agencies, Flood control, Navigation, Bank protection, Levees, Mississippi River, Appropriation.

Arkansas shall acquire and convey to the United States all lands and rights-of-way necessary for connections to the approaches of trans-Mississippi River bridges; subject to such flowage, revetment, bank protection, levee or other river control, harbor line and navigation reservations or rights as the Secretary of War may determine are essential for navigation or flood control purposes. (Holt-Florida)
W70-00100

CONDEMNATION BY COUNTY OR CITY FOR FLOOD CONTROL.
Ky Rev Stat Ann sec 104.010 (1963).

Descriptors: *Kentucky, *Flood control, *Cities, *Condemnation, Legislation, Judicial decisions, Legal aspects, Adjudication procedure, Condemnation value, Land tenure, Real property, Local governments.

Whenever the fiscal court of any county determines that any interest in real property is needed for the purposes of flood control and the fiscal court cannot acquire such interest by agreement with the owners, the fiscal court shall adopt a resolution setting forth the foregoing facts and ordering the condemnation of the required property. The legislative body of any city shall have the same power to condemn real property for flood control purposes as is given to the fiscal court. This section is intended to constitute an alternate method of acquiring property for flood control purposes, in addition to, and not as a substitute for, any other method authorized by law. (Heckerling-Florida)
W70-00101

HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
168 SE2d 293-298 (W Va 1969).

Descriptors: *West Virginia, *Administrative agencies, *Remedies, *Riparian rights, Damages, Land tenure, State governments, Soil conservation, Jurisdiction, Flood protection, Easements, Right-of-way, Access routes, Water law, Dams, Dam construction.
Identifiers: *Soil conservation districts, Injunctions (Mandatory).

Plaintiffs owned land through which a small stream flowed. The state Soil Conservation Committee owned the tract above plaintiffs' land. The Committee granted an easement to the Potomac Valley Soil Conservation District to come upon its land to construct a dam. Since the only access to the dam site was over plaintiffs' land, the Committee obtained a temporary injunction against plaintiffs' interferring with the proposed construction. In order to get heavy equipment to the site, the construction company widened the right of way across plaintiffs' land. Subsequently the court dissolved the temporary injunction and limited the access to the original right of way. Plaintiffs then filed two suits to recover damages and enjoin construction of the flood-prevention dam which plaintiffs claimed would interfere with their lower riparian rights. In answer to certified questions from the court in which the suits were filed, the Supreme Court of Appeals of West Virginia held the Committee to be a state agency having immunity from suit. The court held that the Soil Conservation District could be sued, however, since it was not statewide, but local in scope and nature. The court further found proper venue to be any county within the district. (Harris-Florida)
W70-00102

SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).

301 NYS 2d 935-938 (1969).

Descriptors: *New York, *Water supply, *Administrative decisions, *Permits, Water works, Facilities, Potable water, Water storage, Judicial decisions, Wells, Utilities, Administrative agencies, Water demand, Water policy, Water requirements, Municipal water.

Petitioner, a private domestic water corporation, sought approval from the Water Resources Commission of a plan to supply water to a subdivision. Petitioner's supply system consisted of mains, two 1,000-gallon-per-minute wells, and two 15,000 gallon hydropneumatic storage tanks. The Commission rejected petitioner's plan, concluding that it was not justified by public necessity and that the Suffolk County Water Authority should continue to serve the area with its system of 22 wells, a storage capacity of 5.5 million gallons, water testing facilities, and maintenance crew. On review of the Commission order, the New York Supreme Court held that the conditions attached to the original grant to the Suffolk County Water Authority that they not enter competition with, or parallel the distribution of, any existing waterworks system had not been violated since petitioner was not then in existence or legally assigned to service the subdivision in question. The commission's order was affirmed, and the county water authority was allowed to continue supplying water to the subdivision. (Harris-Florida)
W70-00103

JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
For primary bibliographic entry see Field 04C.
W70-00104

STATE PLANNING: MISCELLANEOUS PROJECTS.
Ky Rev Stat Ann sec 147.100 (1963).

Descriptors: *Kentucky, *Project planning, *Administrative agencies, *Water resources development, Legislation, Drainage, Sewerage, Water supply, Surveys, Harbors, Mapping.

The Governor's Cabinet may make maps, planning studies and surveys relating to port, harbor and waterway work, water supply, drainage and sewerage. (Heckerling-Florida)
W70-00105

FISH AND WILDLIFE RESOURCES.
Ky Rev Stat Ann secs 150.010-150.025 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Wildlife conservation, *Resource development, *Administrative agencies, Fish conservation, Legislation, Legal aspects, Fish, Wildlife, Resources, Fishing, Dams, Impounded waters, Navigable waters, Regulation, Conservation, Recreation, Eminent domain, Water policy, Water resources development, Natural resources, Wildlife management.
Identifiers: *Wildlife resources, Public waters.

Included among the terms defined are: 'angling', 'impounded waters', 'navigable waters', 'public waters', 'regulation', 'wildlife', and 'fi shing.' 'Navigable waters' are any waters within the state under lock and dam. 'Public waters' are all waters within the state flowing a natural stream channel or impounded on a natural stream. The term 'impounded waters' includes any public waters backed up behind a dam including all water upstream from the dam to the first riffle or shoal. It is state policy to protect and conserve wildlife so as to insure a permanent and continued supply of wildlife resources for the purposes of furnishing sport and recreation. The Department of Fish and Wildlife Resources is established to enforce the laws and regulations adopted under this chapter relating to wildlife and will exercise all powers necessarily incident thereto. The administrative organization and workings of the Department are set out; a commission is created to transact the business of the Department. The commission has extensive regulatory powers enabling it to provide for the conservation of the wildlife of the state. (Keith-Florida)
W70-00106

INTERSTATE WATER SANITATION BOARD.
For primary bibliographic entry see Field 05G.
W70-00107

COUNTY BRIDGE CONSTRUCTION.

Ind Ann Stat secs 36-1901 thru 36-1912 (1949), as amended, (Supp 1968).

Descriptors: *Indiana, *Bridges, *Tunnel construction, *Local governments, Bridge construction, Cities, Streams, Legislation, Highways, Repairing, Grading, Construction, Highways, Tunnels, Navigable waters, Financing, Cost allocation.

The board of commissioners of any county shall direct the repair or construction of highway bridges when required by public convenience. The boards may purchase any toll bridge or buy any interest

therein. Whenever any bridge company abandons any bridge or when the right to take toll has expired, the boards may require the bridge and the grade leading thereto to be repaired. The board of commissioners of every county shall cause all bridges to be kept in repair. The boards may build or repair any bridge within the city limits of any city or town, but the rights of such city or town to build or repair bridges are not thereby impaired. The boards may construct a tunnel under a navigable stream in lieu of a bridge. Any county having three or more second class cities may pay up to fifty percent of the cost of repair, reconstruction, or replacement of any damaged bridge which serves as a main means of ingress and egress for such a city, provided fifty percent of such cost is raised by popular subscription. City and county officials may establish a cumulative bridge fund. (Smith-Florida)
W70-00108

TOWNSHIPS AND COUNTY LINE BRIDGES.
Ind Ann Stat sec 36-2101 (1949).

Descriptors: *Indiana, *Bridge construction, *Local governments, *Boundaries (Property), Bridges, Streams, Legislation, Repairing, Appropriation.

Whenever a petition which is signed by twenty-five freeholders of any township which is bounded by a stream forming the boundary line between two counties is presented to the board of commissioners of any county, and such petition asks such township to make an appropriation for the construction or repair of a free bridge for highway purposes only across such stream, the board of commissioners shall enter such petition in their records. (Smith-Florida)
W70-00109

FERRIES ON STREAMS BORDERING STATE.
Ind Ann Stat secs 36-2501 thru 36-2513 (1949), as amended, (Supp 1968).

Descriptors: *Indiana, *Regulation, *Permits, *Transportation, Administrative decisions, Administrative agencies, Maintenance, Rivers, Streams, Lakes, Ohio River, Damages, Legal aspects, Legislation, Rates, Local governments, Navigation, Boats.
Identifiers: *Penalties (Criminal), *Ferries, *Ferry regulation.

A license must be acquired from the appropriate county or city officials before any public ferry may be operated on a stream connecting Indiana with any point without the state. Applicants for licenses must post public notice of their application. The respective officials may issue five-year licenses provided the licensee posts a bond which will insure regular ferry service and maintenance. Unlicensed ferriage across the Ohio or Wabash rivers subjects one to pay damages to the licensed ferry unless enumerated circumstances exist. Cities issuing ferry licenses are authorized to fix rates, set rules of operation, and schedule the operations of said ferries. Licenses may be vacated by the cities granting them if cause is shown. Licensees who violate either city or county license conditions shall be guilty of a misdemeanor and subject to a fine upon conviction. (Holt-Florida)
W70-00110

INDIANA STATE TOLL BRIDGE COMMISSION.

Ind Ann Stat secs 36-3002, 36-3004, 36-3005, 36-3006, 36-3006a, 36-3007 (1949), as amended, (Supp 1968).

Descriptors: *Indiana, *Bridges, *Administrative agencies, *Interstate rivers, Administrative decisions, Bridge construction, Rivers, Streams, Legislation, Public benefits, Riparian rights, Investigations, Eminent domain, United States, Condemnation, Interstate, Appropriation.
Identifiers: *Ferries.

The Indiana State Toll Bridge Commission is authorized and empowered to construct and/or acquire by purchase or condemnation highway bridges and their approaches over and across any river or stream bounding the state whenever said bridge or approach will extend into Indiana. This act applies notwithstanding the fact that such stream is partially or wholly within a bordering state. The Commission is authorized to make investigations to determine if the above constructions or acquisitions would be in the public interest. To facilitate such investigations, engineers and other professionals may be retained. When and if the Commission determines that construction or acquisition of an interstate bridge is in the public interest, they shall make a resolution declaring such determination. The Commission is authorized to purchase all lands and riparian rights necessary for construction or acquisition of said bridges. The Commission shall purchase at a fair price any ferry that has operated continuously for 15 years within 2 miles of a proposed bridge site. The Commission is given the power of eminent domain. (Holt-Florida)
W70-00111

PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
For primary bibliographic entry see Field 03E.
W70-00112

SEWERS AND DRAINS IN CITIES AND TOWNS.

Ind Ann Stat secs 48-3915 thru 48-3923 (1963).

Descriptors: *Indiana, *Sewage, *Drainage systems, *Sewage disposal, Legislation, Legal aspects, Cities, Leases, Contracts, Construction, Maintenance, Drains, Sewers, Cost allocation, Bids, Taxes, Assessments, Pumping plants, Water purification, Public health, Environmental sanitation, Financing, Projects, Administration.
Identifiers: *Joint projects.

Any city or town may build or otherwise acquire a general sewage system together with all the property rights and privileges connected therewith; cities and towns may also purchase or lease other lands for erecting pumping stations or other buildings in connection with said sewage system. Methods of financing, voter approval, and payment of taxes for such systems are specifically enumerated. The terms 'sewer', 'drain', 'sewerage and drainage system' and 'drainage or sewerage facilities' are construed to mean and include any local, main, collateral, connecting or interceptor sewer or drain, or any system, works, plant or other structure necessary for the collection, treatment, filtration, purification or sanitary disposal of the sewage and drainage of such cities and towns. Provision is made for the joint acquisition or construction of sewage systems or parts thereof by adjoining cities; the administrative procedures to be used in reaching agreement, cost allocation, bid advertisement, contract letting and financing for all such joint efforts are provided. (Keith-Florida)
W70-00113

INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.

Ind Ann Stat secs 68-401 thru 68-405 (1961).

Descriptors: *Port authorities, *Interstate commissions, *Illinois, *Indiana, State governments, Harbors, Great Lakes Region, Lake Michigan, Mississippi River, Programs, Administrative agencies, Legislation, Interstate compacts, Transportation, Navigation, Breakwaters, Engineering structures.
Identifiers: *Commercial development, Water terminals, Port and waterway development, Port districts

This act witnesses a compact between Indiana and Illinois that creates a governmental body to coordinate port and waterway development programs in the Chicago-Lake Michigan area. Within the agreement's thirteen articles are provisions for the jurisdiction, specific powers, and duties of the port authority. The port district consists of the waters of Lake Michigan within the respective boundaries of the two states and all of the rivers common to the states, including all harbors, piers, breakwaters, and structures therein. The port authority is given the power to acquire, own, construct, lease, operate, and maintain such port and water terminal facilities as are specifically authorized by the legislature of either state. The duties of the port authority are to study, prepare, and recommend by specific proposals such changes and modifications as may be required to develop and maintain a full development of commerce in the port district. Both states pledge mutual cooperation and agree to share the expenses of the port authority except for the creation of a terminal facility within one of the states. (Schram-Florida)
W70-00114

REGISTRATION OF MOTORBOATS.

Ind Ann Stat secs 68-1101 thru 68-1110 (1961), as amended, (Supp 1968).

Descriptors: *Indiana, *Boating regulations, *Legal aspects, *Boats, Regulations, Safety, Federal government, State governments, Conservation, Jurisdiction, State jurisdiction, Bodies of water, Legislation, Administrative agencies.
Identifiers: Registrations.

Every motorboat operating on the waters of the state must be registered with the Department of Conservation and numbered. A registration must be renewed every three years. Boats numbered under a federally approved numbering system using state waters for less than ninety consecutive days need not register in this state, nor do motorboats of the United States, a state, or a subdivision thereof. Every peace officer of the state and any conservation officer may enforce this act. Violations of this act are a misdemeanor. (McDonough-Florida)
W70-00115

INDIANA PORT COMMISSION.

Ind Ann Stat secs 68-1201 thru 68-1227 (1961), as amended, (Supp 1968).

Descriptors: *Indiana, *Port authorities, *Construction, *Financing, Federal government, Lake Michigan, Riparian rights, Harbors, Canals, Canal construction, Docks, Capital costs, Construction costs, Government finance, Eminent domain, Taxes, Income, Transportation, Legal aspects, Legislation, Planning, Public utilities, Administrative agencies.

The Indiana Port Commission is a five-member commission appointed by the Governor to construct a modern port with terminal facilities for all forms of transportation on Lake Michigan and/or on the Ohio River in designated counties. The Commission is authorized to issue revenue bonds to finance construction. The general powers of the Commission include: (1) the preparation of plans and contracts for port facilities; (2) the acquisition of land by purchase, lease, and eminent domain; (3) the relocation of public roads, railroad and public utility facilities which shall be payable as costs of construction; (4) the issuance of port revenue bonds, which are not to be considered debts of the state; and (5) the setting of fees and charges. All income is to be considered trust funds for port purposes. The Commission and its bonds are given certain tax exemptions. The Commission is authorized to apply for permission to operate a foreign-trade zone and to construct canals and waterways. (McDonough-Florida)
W70-00116

FISHING THROUGH ICE HOLES.
Ind Ann Stat secs 11-1615, 11-1615a (Supp 1968).

Descriptors: *Indiana, *Fishing, *Regulation, *Ice fishing, Legislation, Legal aspects, Permits, Lakes, Rivers, Streams, Structures, Obstruction to flow, Fishing gear, Permits, Water utilization, Fish conservation, Water conservation.
Identifiers: Penalties (Criminal), Fishing licenses.

It is unlawful to fish in any of the lakes, rivers, or streams of the state through more than two holes in the ice at one time or through a hole more than twelve inches in diameter. Any structure used in such fishing must meet specified requirements and must be removed from the ice before the ice melts. Fishing licenses and permits issued to nonresidents whose home states do not allow nonresidents to fish through the ice shall not be deemed to permit the holder thereof to fish through the ice. Violators of this provision are subject to criminal penalties. (Keith-Florida)
W70-00117

FISH LADDERS - REGULATIONS.

Ind Ann Stat secs 11-1617, 11-1618 (1956).

Descriptors: *Indiana, *Fish ladders, *Dams, *Regulation, Legislation, Rivers, Watercourses (Legal), Cities, Construction costs, Maintenance, Legal aspects, Repairing, Fish migration.
Identifiers: Liens.

The owners of any dam which is over four feet in height and which crosses any watercourse of this state shall construct and maintain fish ladders on such dam to allow fish below the dam to travel to the waters above the dam. If the owner does not erect the ladders, the trustee of the township where the dam is located may construct such ladders, and the cost shall constitute a lien on the dam. If the owner continues to refuse to pay the cost of the ladders, the trustee may sue to recover the amount and may foreclose the lien on the dam. The owners shall be required to keep the ladders in good repair. The trustee of the township, after 30 days notice to the owner, may make such repairs if the owner fails to do so. He may recover the costs as provided above. It shall be unlawful to fail to repair the fish ladders required under these provisions. (Heckerling-Florida)
W70-00118

MUSSELS - REGULATIONS.

Ind Ann Stat secs 11-1644 thru 11-1648 (1956).

Descriptors: *Indiana, *Mussels, *Wildlife conservation, *Regulation, Legislation, Wildlife management, Commercial shellfish, Shellfish, Fishing gear, Beds under water, Breeding, Commercial fishing.
Identifiers: Breeding grounds.

No person shall catch, possess, or sell any mussel less than two inches in size. Any mussel smaller than the above size shall be culled and immediately returned to the water. Only one boat or rig for taking mussels may be operated by one person at any time. No crowfoot bar, dredge, fork, shovel, or spade, or any other device used in scraping, digging, spading, or otherwise disturbing the bed of any waters, shall be used in taking mussels from April 1 through June 13. The Wabash River shall be exempted from this section for purposes of the use of the above devices. It shall be unlawful to have more than the herein prescribed numbers of certain devices used in taking mussels. Certain waters may be designated as breeding grounds for mussels from which mussels shall not be taken for designated periods of time. Limits are prescribed for the sizes of breeding grounds. Notice of such regulation shall be made public in the prescribed manner. No person shall take or kill mussels in any area or parts of the waters of this state closed during the time prescribed by regulation. (Heckerling-Florida)
W70-00119

OPEN SEASON AND BAG LIMITS.

Ind Ann Stat secs 11-1701 thru 11-1708 (1956).

Descriptors: *Indiana, *Regulation, *Wildlife conservation, *Administrative decisions, Legislation, Legal aspects, Fish, Frogs, Mussels, Reproduction, Conservation, Fish conservation, Lakes, Streams, Rivers, Ponds, Bodies of water, Administrative agencies, Wildlife, Wildlife management.
Identifiers: *Open seasons, *Bag limits, Penalties (Criminal).

Seasons and limits on fish, frogs, mussels, game, fur bearing animals and game birds, as well as regulations for the taking and killing thereof are established. The Director of the Department of Conservation may, however, modify such seasons, limits, and regulations in the interest of wildlife conservation. Any decision of the Director to modify statutory seasons, limits, and regulations must be based on an investigation reflecting the production, preservation, and propagation of the species involved. Criminal penalties are provided for the violation of any regulation or order of the Director. The term 'waters' is defined to include any lake, stream, river, pond, or body of water and all chains, systems, or combinations thereof within the state. (Keith-Florida)
W70-00120

STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.

Ind Ann Stat secs 11-1901 thru 11-1902, 11-1904 (1956).

Descriptors: *Indiana, *Fish reproduction, *Migratory birds, *Wildlife conservation, Legislation, Legal aspects, Drainage, United States, Federal government, Jurisdiction, Fish conservation, Administrative agencies, Permits, Treaties, Lakes, Streams, Multiple-purpose projects, Federal reservations, Conservation, Project purposes, Water policy, Federal project policy.
Identifiers: *Fish restoration, *Federal-state cooperation, Federal projects.

The United States may acquire such lands and water in the state as it deems necessary for the establishment of migratory-bird reservations in accordance with the federal migratory-bird treaty of 1929. The treaty's purpose is to lessen the dangers threatening migratory game birds from drainage and other causes. The United States commissioner of fisheries may conduct fish hatching operations and related investigations within the state in order to promote fish culture and to increase the number of useful food and game fishes in the lakes and streams of the state. The state assents to an act of Congress providing for aid to the states in fish restoration and other management projects. The director of the division of fish and game may perform such acts as may be necessary to establish cooperative fish restoration projects. No funds accruing to the state from fishing license fees may be diverted for any other purpose than the administration of the division of fish and game and for the protection, propagation, and investigation of fish and game. (Keith-Florida)
W70-00121

WATERCOURSES - CANALS - TOLL BRIDGES.

Ind Ann Stat secs 26-1413 thru 26-1417 (1960), as amended, (Supp 1968).

Descriptors: *Indiana, *Channel improvement, *Stream improvement, *Cleaning, Obstruction to flow, Canals, Appropriation, Repairing, Legislation, Non-navigable waters, Channels, Financing, Administrative agencies, Local governments, Costs, Maintenance costs.
Identifiers: Toll bridges, counties.

The Board of County Commissioners of any county may, for the purpose of navigation, appropriate money for canal repair. The Board may purchase any toll bridge or private interest therein. Upon petition by owners of frontage land bordering on any non-navigable stream requesting that a specified portion of such stream be cleaned or improved to provide adequate capacity, the Board shall refer such petition to the county surveyor for examination. The Board may also determine, in the absence of petition, that such stream needs cleaning or improving. After a hearing, the Board may provide that necessary work be performed by the county or let for contract. Commencement of such work is subject to approval of the County Council which shall make an appropriation to cover the costs thereof. This act shall not apply to ditches or drains already established by a court and for which a maintenance district exists. Where the non-navigable stream forms a boundary between two counties, the petition to improve shall be filed with both counties. The boards of the counties shall proceed in joint action and the costs shared equally. (Marsee-Florida)
W70-00122

PROTECTION OF LAKES.
For primary bibliographic entry see Field 04A.
W70-00123

WATER LEVEL PROTECTION.
For primary bibliographic entry see Field 04A.
W70-00124

WATER LEVEL PROTECTION.
For primary bibliographic entry see Field 04A.
W70-00125

WATER LEVEL STABILIZATION.
For primary bibliographic entry see Field 04A.
W70-00126

WATER LEVEL PROTECTION (LAKES).
For primary bibliographic entry see Field 04A.
W70-00127

STUDY OF WATER RESOURCES AND MANAGEMENT.
For primary bibliographic entry see Field 06B.
W70-00128

MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.

Ind Ann Stat secs 27-1801 thru 27-1808 (Supp 1968).

Descriptors: *Indiana, *Flood control, *Operation and maintenance, *Flood protection, Diversion structures, Dams, Levees, Construction, Water management (Applied), Watershed management, Planning, Engineering structures, Dam construction, Design, Costs, Construction costs, Assessments, Taxes, Inspection, Surveys, Legislation, Legal aspects.
Identifiers: Penalties (Criminal).

The owner of any dam, levee, dike, or floodwall and appurtenant works must keep the structure in repair and/or satisfactory operating condition. The Indiana Flood Control and Water Resources Commission is charged with supervision over the status of repair of such structures and may make rules and regulations for their maintenance and operation. The Commission may vary these standards where location of the structure or particular hazzards involved so require. The Commission is directed to make annual engineering inspections of all dams, levees, dikes, and floodwalls with certain exceptions noted in the statute. The Commission may order such repairs or reconstruction of defective works as are required to meet its standards. In emergencies, where life and property are endangered, the Commission may take steps to provide

emergency protection and may recover the costs for same from the owner. Refusal to comply with Commission repair orders may subject the owner to prosecution for a misdemeanor. The Commission may enter land for engineering inspections without liability for trespass and is exempt from liability for injury arising from faulty construction or repair of dams and other works or from issuance and enforcement of any lawful order. (Kelly-Florida)
W70-00129

RESERVOIR SITES FOR STORAGE OF WATER.

Ind Ann Stat secs 27-1901 thru 27-1908 (Supp 1968).

Descriptors: *Indiana, *Water conservation, *Water management (Applied), *Water storage, Water yield improvement, land use, Easements, Water demand, Water utilization, Reservoirs, Reservoir operation, Water allocation (Policy), State governments, Legal aspects, Legislation, Water sources, Costs, Flood control, Water control, Water resources, Condemnation, Administrative agencies, Local governments.

Municipalities, Taxing districts, and public utilities may secure reservoir sites for future needs which are determined by factors including growing domestic and other uses of water, pollution control, and flood control and prevention. The state Flood Control and Water Resources Commission is empowered to purchase or condemn lands or interests in land for reservoirs and to construct structures for water impoundment. This may be done on behalf of the state or any municipality, taxing district, or public utility which has the right and duty to store water for purposes stated in this statute. The owner of any land from which an easement or remainder interest is taken may use the land for recreational, agricultural, or other purposes, subject to the dominant purpose of water storage. The state Board of Health and the Commission must approve the taking of land for the purposes of this act by any party other than the Commission. (Kelly-Florida)
W70-00130

INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
Ind Ann Stat secs 27-2001 thru 27-2017 (Supp 1968).

Descriptors: *Indiana, *Drainage programs, *Drainage practices, *Planning, Operation and maintenance, Maintenance, Construction, Construction costs, Maintenance costs, Assessments, Regulation, Design standards, Specification, Local governments, Legislation, Drainage engineering, Surveys, Surface drainage, Legal aspects, Classification, Administrative agencies, Administration, Repairing.
Identifiers: *Drainage boards.

County drainage boards are established in each county of the state. Membership includes county commissioners, the county surveyor, and a city engineer in appropriate cases. The county surveyor is the technical authority on construction and maintenance of all legal drains in the county and is responsible for investigation and planning of needed improvements and for preparing standards of design, construction, and maintenance applicable to all legal drains. The surveyor must supervise all work on improvements and maintain complete records concerning all legal drains in the county. The surveyor is charged with maintaining a classification system of all drains in the county with regard to maintenance and reconstruction needs and desirability of vacating drains. The statute sets forth criteria for classification, gives examples of types of needed repair which may be made, and outlines the manner in which repair or vacating may be accomplished. Costs of public drain improvements may be assessed against benefited land owners, the pro rata share to be determined by the board. A joint board will preside over proceedings involving improvements affecting land in two or more counties. (Kelly-Florida)
W70-00131

CONSTRUCTION OF DRAINS.

Ind Ann Stat secs 27-2101 thru 27-2166 (Supp 1968).

Descriptors: *Drains, *Indiana, *Drainage engineering, *Drainage programs, Drainage practices, Drainage, Land management, Costs, Construction costs, Drainage effects, Surface drainage, Drainage systems, Cost allocation, Damages, State governments, Local governments, Legal aspects, Legislation, Planning, Cost-benefit theory, Estimated costs, Construction, Maintenance, Administrative agencies, Maintenance costs, Administration, Surveys, Assessments.

Where establishment of a new legal drain cannot be easily accomplished without affecting other property, owners of land affected by the proposed improvement may petition the drainage board for the establishment of the new drain. Petitions may also be filed by county commissioners for highway drainage, by school trustees for drainage of public school grounds, or city officials for drainage with the corporate limits. The statute sets forth the necessary content of the petition, procedure for filing, and procedure to be followed by the board in hearing, investigating and deciding petitions. The county surveyor shall, at the board's request, determine the type of drainage structure to be used, prepare plans for construction, and determine costs. The board may, after proper hearings, assess costs against the benefited landowners. The board may refer to the surveyor those drains in need of reconstruction or those drains in need of periodic maintenance for reports by him concerning plans for reconstruction or maintenance, and estimates of costs, including damage awards, which may be assessed against benefited landowners after public hearings. (Kelly-Florida)
W70-00132

DRAIN IMPROVEMENT.
Ind Ann Stat secs 27-2401 thru 27-2420, 27-2501 thru 27-2507 (Supp 1968).

Descriptors: *Indiana, *Drainage systems, *Costs, *Local governments, Drainage, Ditches, Drainage programs, Drainage districts, Controlled drainage, Maintenance, Maintenence costs, Construction costs, Replacement costs, Cost allocation, Cost-benefit analysis, Cost sharing, Legislation, Assessments, Tile drains, Financing, Operation and maintenance.

There is created in each county a general drain improvement fund which shall be used to pay the cost of constructing, reconstructing, or maintaining a legal drain. A maintenance fund is created for each legal drain. The county auditor shall set up a separate account for each drain and shall assess the lands benefited for the periodic maintenance costs. When even the cost of maintaining any tile drain does not exceed one hundred dollars, such drain may be exempted from this act, and the costs shall be paid from the general drain improvement fund. Bonds may be issued and redeemed to finance such maintenance. The drainage board has the power to contract for improvement and maintenance work. The board shall apportion all costs to the several tracts of land benefited. A ditch assessment lien shall attach to the lands assessed on the date of certification of the final assessment. Whenever the cost is more than can be conveniently paid by assessment, the sale of bonds shall be authorized. Any owner of land affected by a final order of a drainage board shall be entitled to judicial review thereof. (Smith-Florida)
W70-00133

RIVER IMPROVEMENTS BY THE UNITED STATES.
Ind Ann Stat secs 62-1007, 62-1010 (1962).

Descriptors: *Indiana, *Navigable rivers, *Condemnation, *United States, Legal aspects, Legislation, Rivers, Locks, Dams, Chutes, Abuttments, Structures, Construction, Maintenance, Navigation, Jurisdiction, Ohio River, Banks, Federal government, Dam construction.
Identifiers: *River improvements.

The United States may acquire any property for the purpose of erecting thereon dams, abuttments, locks, lock-keepers' houses, chutes, and other structures necessary for the construction and maintenance of slack water navigation on navigable rivers. The consent of the state to such acquisition is contingent on the beginning by the United States of the improvement of a navigable river within or bordering upon the state. Such acquisition may be either by purchase or condemnation. The United States is granted specific permission to purchase any land on the banks of the Ohio or Wabash rivers provided that it is purchased to erect thereon structures necessary to the improvement of said rivers. (Keith-Florida)
W70-00134

DUTIES OF THE DEPARTMENT OF CONSERVATION.
For primary bibliographic entry see Field 05G.
W70-00135

CONSERVATION DEPARTMENT.

Ind Ann Stat secs 60-725a, 60-736, 60-737, 60-748 thru 60-750 (1962).

Descriptors: *Indiana, *Surface waters, *Water conservation, *Flood control, Legislation, Legal aspects, Artificial watercourses, Conservation, Condemnation, Eminent domain, Recreation facilities, Streams, Obstruction to flow, Lakes, Rivers, Water levels, Drainage, Navigable rivers, Navigable waters, Non-navigable waters, Administrative agencies, Public benefits, Federal government.
Identifiers: *Man-made lakes.

The Department of Conservation may acquire surface water rights on certain man-made lakes. With certain restrictions the Department may also acquire land adjacent to such man-made lakes for purposes of public access and recreation. The Department must approve all plans for flood control projects before work on them begins. The Department of Conservation by itself or in conjunction with the federal government must clean out, straighten, deepen, widen, remove obstructions from, and clear the banks of specified portions of the Little Calumet River. The Department is empowered to become a party to any legal action in any state court when such action affects the preservation or maintenance of the lakes, rivers, or streams of the state; all state courts must recognize this right of the Department. The definition of 'lakes' includes both meandered and unmeandered lakes, and the term 'rivers' is defined to include both navigable and nonnavigable rivers and streams. (Keith-Florida)
W70-00136

BANKS V CHICAGO MILL AND LUMBER CO (ACCRETIONS TO RIPARIAN LAND).

92 F Supp 232-242 (ED Ark 1950).

Descriptors: *Arkansas, *Accretion (Legal aspects), *Boundaries (Property), Judicial decisions, Bank erosion, Avulsion, Boundary disputes, Islands, Navigable rivers, Rivers, Shores, Banks, Riparian land, Riparian rights, High water mark, Water rights, Sedimentation, Stream erosion, Severance.

Both parties claim title to riparian land. Defendant's claim is based on evidence that the land had been formed as accretions to the bank of the river and subsequently separated therefrom by avulsive change of the river. Plaintiff claims that the land had moved from one bank of the river to the op-

posite by avulsion and later moved back by subsequent avulsion. A riparian owner whose land is added to by gradual and imperceptible accretion gains title to the new land. He also loses land washed away by gradual erosion. However, where a stream suddenly changes course by avultive action the riparian owner retains title to submerged land or island if one is formed. Avulsion causes no change in boundaries. The court found that the land in question formed by the gradual deposit of silt and sediment was later to be cut off from the bank by avulsion of the river establishing defendant's title. (Helwig-Florida)
W70-00165

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
For primary bibliographic entry see Field 05G.
W70-00167

WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-00168

ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).
For primary bibliographic entry see Field 04A.
W70-00169

ACCRETION - A NEW SLANT,
For primary bibliographic entry see Field 04A.
W70-00170

CHICAGO SANITARY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00171

CHICAGO SANITARY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00172

CHICAGO SANITARY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00173

CHICAGO SANITARY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00174

CHICAGO SANITARY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00175

GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
For primary bibliographic entry see Field 04C.
W70-00176

STRIP MINING.
For primary bibliographic entry see Field 05G.
W70-00177

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.
For primary bibliographic entry see Field 05G.
W70-00178

WATER WELL DRILLERS.
For primary bibliographic entry see Field 04B.
W70-00179

TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
For primary bibliographic entry see Field 04A.
W70-00180

TORTS - NUISANCE: INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
For primary bibliographic entry see Field 05G.
W70-00181

EXTENT OF PRIVATE RIGHTS IN NON-NAVIGABLE LAKES,
For primary bibliographic entry see Field 04A.
W70-00182

RIPARIAN RIGHTS IN GEORGIA,
For primary bibliographic entry see Field 04A.
W70-00183

A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
For primary bibliographic entry see Field 06D.
W70-00184

WATER LEGISLATION,
For primary bibliographic entry see Field 06D.
W70-00185

RIVERS STREAMS AND WATERWAYS.
For primary bibliographic entry see Field 05G.
W70-00186

MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
261 Wis 492, 55 NW2d 40-48 (1952).

Descriptors: *Wisconsin, *Public benefits, *Navigable waters, *Public rights, Administrative agencies, Judicial decisions, Local governments, Dams, Dam construction, Navigation, Hunting, Fishing, Scenery, Legal aspects, Water law, Water policy, Competing uses, Governments, Recreation, Water allocation (Policy), Water resources development.
Identifiers: *Delegation doctrine.

Petitioner was granted a rehearing on a petition to review the decision of the Public Service Commission which authorized the construction of a dam. The issue on rehearing was the constitutionality of the statute under which the Commission had authorized said construction. Petitioner contended that the statute was void as an improper delegation of legislative power because it attempted to delegate to the county boards the power to determine the effects of dam construction on the public right to the enjoyment of fishing, hunting, and scenic beauty which are matters of state-wide not local concern. The court held this statute unconstitutional as an unlawful delegation of legislative authority and as constituting a complete abdication of the public trust doctrine under which the state holds all navigable waters in trust for the public. This trust extends to the use of such waters for fishing, hunting, and other recreational purposes, as well as to pure navigation. The right to hunt and fish are matters of state-wide concern over which the power to legislate cannot constitutionally be delegated to county boards. The previous mandate of reversal was affirmed. (Johnson-Florida)
W70-00187

SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).
For primary bibliographic entry see Field 03E.
W70-00188

FLOOD CONTROL AND WATER USAGE.
For primary bibliographic entry see Field 04A.
W70-00189

SEWERS AND DRAINS IN CITIES AND TOWNS.
For primary bibliographic entry see Field 04C.
W70-00190

NAVIGABLE WATERWAYS.
For primary bibliographic entry see Field 04A.
W70-00191

CHICAGO REGIONAL PORT COMMISSION.
For primary bibliographic entry see Field 04A.
W70-00192

WABASH VALLEY COMPACT.
For primary bibliographic entry see Field 04D.
W70-00193

PORT AUTHORITIES.
For primary bibliographic entry see Field 04A.
W70-00194

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
For primary bibliographic entry see Field 04A.
W70-00195

OHIO RIVER AREA COORDINATING COMMISSION.
For primary bibliographic entry see Field 06B.
W70-00196

LEVEE AUTHORITY DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00197

WATER RIGHTS.
For primary bibliographic entry see Field 04C.
W70-00198

FISH AND WILDLIFE RESOURCES.
For primary bibliographic entry see Field 03E.
W70-00199

FLOOD CONTROL SYSTEMS.
For primary bibliographic entry see Field 04A.
W70-00200

FISH AND GAME (FISHING REGULATIONS).

Ark Stat Ann secs 47-401 thru 47-420 (1964).

Descriptors: *Arkansas, *Fish, *Sport fishing, *Commercial fishing, Legislation, Regulation, Recreation, Fresh water fish, Fish, Bass, Perch, Salmon, Pikes, Trout, Minnows, Fishing equipment, Bait fishing, Nets.
Identifiers: *Penalties.

Arkansas regulations concerning game fish are set forth. Provisions concerning bait, minimum length, and string limit are provided. Minnow regulations include closed season provisions, exportation, seine and licensing restrictions. The use of hook and line, traps, gigs, spears, explosives, and intoxicating substances to take fish is restricted. Licensing and the use of seines, trammel and gill nets for commercial fishing are regulated. Provisions concerning the use of hoop, barrel, or pond nets and penalties for violations thereof are included. Specific geographic and date limitations on the use hoop nets and commercial troutlines, snag lines, gigs, or spears, together with licensing provisions are set forth. Predatory fish removal and control provisions are included. (Moulder-Florida)
W70-00212

DRAINAGE IMPROVEMENT DISTRICTS; REMOVAL OF STREAM OBSTRUCTIONS.
For primary bibliographic entry see Field 04A.
W70-00225

FISH AND GAME (MUSSELS)

Ark Stat Ann secs 47-601 thru 47-604 (1964).

Descriptors: *Arkansas, *Mussels, *Mollusks, *Shellfish, Clams, Regulation, Legislation, Administration, Boats, Dredging, Fishing gear, Fishing equipment, Commercial fishing, Taxes, Wildlife management, Administrative agencies.
Identifiers: *Penalties.

Arkansas mussel takers and buyers must conform to certain regulations. An annual shell taker's license must be procured, under which the possessor may operate not more than one boat or rig for taking mussels plus one boat for towing. It is unlawful to use more than two crow feet bars or one dredge. Minimum size restrictions are set forth. In addition persons buying mussel shells must procure a license from the fish and game commission. Every person who runs a boat for the purpose of dealing in fresh-water mussel shells shall procure a license. The holder of a shell buyer's license must make an annual report to the fish and game commission. There is no severance tax. The Arkansas game and fish commission shall enforce these laws. The commission may also set up restricted areas where mussel fishing is prohibited. Penalties for infractions are provided. (Moulder-Florida)
W70-00236

UTILITIES AND INDUSTRIES CORP V STATE (EMINENT DOMAIN).

24 NYS2d 756, 299 NYS2d 851-852 (1969).

Descriptors: *New York, *Eminent domain, *Water policy, *Damages, Water law, Condemnation, Legal aspects, Right-of-way, Water rights, Adjudication procedure, Appropriation, Preferences (Water rights), Prescriptive rights, Administrative agencies, Competing uses, Relative rights, Water supply.

Respondent state took a strip of land from appellant for purposes of a controlled access highway which left appellant with land on both sides of the highway. While appellant retained access to the land east of the highway, the superintendant of public works gave access to land west of the road only if appellant used such land for public water supply purposes. The court held that the landowner was entitled to consequential damages, but that access to the western portion of the property could be conditioned on the continued use of the land as a public water supply. (Johnson-Florida)
W70-00238

MILLS AND MILL DAMS.
For primary bibliographic entry see Field 04A.
W70-00245

JOINT OPERATION OF WATER SOURCES.
For primary bibliographic entry see Field 03D.
W70-00276

BRIDGES, CULVERTS, SEWERS AND WATERCOURSES IN SECOND CLASS CITIES.
Ky Rev Stat Ann sec 84.170 (1963).

Descriptors: *Kentucky, *Bridges, *Cities, *Watercourses (Legal), Culverts, Sewers, Legislation, Administrative agencies, Financing, Administrative decisions, Maintenance, Regulation, Flow augmentation, Alteration of flow, Channel improvement, Channel flow, Artificial watercourses, Natural streams, Legal aspects, Operation and maintenance.

The general council of any second class city may by ordinance: (1) acquire, erect, and maintain bridges within the city and from the city across any water course bounding the city; (2) establish, erect, maintain, and regulate the use of culverts and sewers; (3) establish, alter, deepen, and change the channel of watercourses, both natural and artificial, and wall up and cover such watercourses if necessary. (Heckerling-Florida)
W70-00301

ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.
For primary bibliographic entry see Field 03D.
W70-00304

WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN FLOATABLE STREAMS.
Mich L Rev, Vol 42, No 4, p 712-713, Feb 1944. 2 p, 5 ref.

Descriptors: *Michigan, *Navigable waters, *Ownership of beds, *Public benefits, Riparian rights, Fishing, Streambeds, Non-navigable waters, Relative rights, Prescriptive rights, Judicial decisions, Public rights, Easements, Competing uses, Legal aspects.
Identifiers: *Common law.

This comment is based on an action brought to compel the defendants to restore the bed of a stream flowing through their land to its former condition. The stream was thirty feet in width and averaged in depth approximately one foot. It had a flow of less than fifty cubic feet per second. The stream was not capable of 'commercial travel by any kind of boat', and it was doubtful whether it was 'practical to use a boat on it in fishing.' Although in logging days some loose timber had been floated down it, the stream could never be used to float logs without the use of dams. The court ruled that barriers and holes placed in the stream to prevent waders from entering defendants' land must be removed. Michigan law thus seems settled that the public right of fishing extends even to floatable streams, the beds of which are owned privately. Thus, Michigan and Wisconsin go against the common law rule that the right to fish follows ownership of the bed rather than navigability. Seemingly, capability of use for floating rather than actual use therefore is the determinative factor. (Schram-Florida)
W70-00315

EMINENT DOMAIN.

Ky Rev Stat Ann secs 416.130, 416.140, 416.220 (1963), as amended, (Supp 1968).

Descriptors: *Public utilities, *Dams, *Kentucky, *Eminent domain, Condemnation, Electric power, Navigation, Streams, Highways, Water delivery, Pumping, Legislation, Overflow, Flood damage, Right-of-way, Access routes, Water supply, Easements.

Every corporation organized for the purpose of constructing a dam to improve navigation or to provide water power or electricity when unable to reach an agreement with the owner of needed lands or rights, may condemn the needed property. A corporation maintaining such a dam shall be liable in damages for any overflow. Any company transmitting or selling electricity, gas, or gasoline may acquire rights of way for fixtures and appliances so as to be able to distribute said products to consumers. These fixtures shall not obstruct navigation or travel. An owner of real estate serving the public shall have the right to acquire a right of way to the nearest river or water supply line if adequate water is not available on the property. (Darragh-Florida)
W70-00329

COUNTY LINE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00336

FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
168 SE2d 287-293 (W Va 1969).

Descriptors: *West Virginia, *Condemnation, *Remedies, *State governments, Administrative agencies, Flood damage, Highway relocation, Relative rights, Flooding, Shafts (Excavations), Judicial decisions.
Identifiers: *Sovereign immunity, Abandoned mines.

Plaintiff corporation leased a store in which it kept and sold large amounts of personal property merchandise. The state road commission of West Virginia entered a contract with a construction company to relocate a highway. In the process of relocating, the mouth of an abandoned mine was opened by excavations causing the release of impounded water which flooded plaintiff's leasehold, damaging its personal property. Since the state road commission, as a state agency, was immune to tort suit, plaintiff sought mandamus to compel the defendant commissioner to institute condemnation proceedings against plaintiff's damaged property. On appeal from an order upholding defendant's demurrer, the Supreme Court of Appeals of West Virginia held that although the state constitution provided that no private property be taken or damaged for public use without compensation, the provision was not self-executing. Since the legislature had only provided for condemnation of real estate, no condemnation proceeding would lie for personalty. The court indicated in dicta that plaintiff's only remedy would lie in a tort suit against the contractor. (Heckerling-Florida)
W70-00342

WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.

Minn L Rev, Vol 40, p 88-91, 1955. 4 p, 18 ref.

Descriptors: *Missouri, *Navigable waters, *Ownership of beds, *Public benefits, Streambeds, Riparian rights, Non-navigable waters, Fishing, Relative rights, Eminent domain, Prescriptive rights, Competing uses, Easements, Public rights, Judicial decisions, Legal aspects.
Identifiers: *Public easements.

Navigability and its effect on rights to watercourses is discussed in relation to a recent Missouri case. In that case, plaintiff fisherman requested a declaratory judgement to determine his right to fish in a river navigable in fact by small craft but not navigable in fact by larger boats. The court held that the river was nonnavigable under the Missouri test, and thus the riparian owner had title to the bed of the stream; but since it was 'floatable', such title was subject to a public easement of travel and passage by floating and wading, which includes the right of fishery. After discussing federal and state tests of navigability, the comment explores the issue of whether fishing is rightfully an incident of navigation. The basic contention is that it is possible to reach the same result as the present case by another rationale--the trust theory that title to fish is in the state and thus the public should have a right to take them regardless of who owns the stream beds. Additional theories that are mentioned are dedication, prescription, estoppel, and eminent domain. (Schram-Florida)
W70-00345

FERRIES ON STREAMS WITHIN STATE.

Ind Ann Stat secs 36-2601 thru 36-2618 (1949).

Descriptors: *Indiana, *Transportation, *Boats, *Regulation, Administrative agencies, Legislation, Navigable rivers, Rivers, Streams, Creeks, Banks, Administration, Legal aspects.
Identifiers: *Ferries.

Any person owning land on any creek or river may, upon application to the appropriate board of commissioners and upon compliance with notice provisions, have a public ferry established across said river. A ferry may also be established across a river bounding two counties upon compliance with cer-

tain provisions. The board of county commissioners may establish a ferry where required if the owner of the land fails to have one established. Regulations concerning the number of boats and hands, and ferry man bonding and duty requirements are included, as are provisions for ferrying people without a license. The rates of ferriage are fixed by the board. Ferry landings may not be obstructed. Penalties for violation of the regulatory provisions are set forth. (Moulder-Florida)
W70-00352

TOWNSHIP LINE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00354

BRIDGES OVER CANALS.
For primary bibliographic entry see Field 04A.
W70-00355

POWER TO ACQUIRE CONTROL AND DISPOSE OF PROPERTY.

Ky Rev Stat Ann sec 88.090 (1963).

Descriptors: *Kentucky, *Cities, *Shores, *Real property, Legislation, Coastal structures, Administrative agencies, Leases, Rent, Public benefits, Control, Piers, Legal aspects.

The board of trustees of any sixth class city may purchase, lease, or receive real and personal property which may be necessary for municipal purposes. The board shall have control of such property for the benefit of the city. The board may also dispose of any such property to benefit the city. Waterfront property may not be sold or conveyed, but the board may rent waterfront property for a term not to exceed 20 years. Wharf privileges may be rented for up to 5 years. (Heckerling-Florida)
W70-00364

PUBLIC PARKS-WATERS-POWERS OF THE BOARD.
Ind Ann Stat sec 48-5728 (1963).

Descriptors: *Indiana, *Local governments, *Administrative agencies, *Parks, Maintenance, Rivers, Streams, Assessments, Legislation, Bank protection, Levees, Flow control, Pollution abatement, Water pollution control.

The Board of Park Commissioners shall have power to keep open and clean rivers, streams, and waterways, and they shall improve the banks of such waters, build levees, control water flow, and promulgate rules and regulations concerning any waters within or bounding on any public park. The Board is also empowered to require owners of real estate abutting such waters to remove objectionable pollutants upon five days notice. If such owners fail to comply, the Board may cause such objectionable material to be removed, and the county treasurer shall assess the cost to the property owner. (Darragh-Florida)
W70-00366

LEVEE CONSTRUCTION AND MAINTENANCE.
For primary bibliographic entry see Field 04A.
W70-00367

WATERSHED CONSERVANCY DISTRICTS.
For primary bibliographic entry see Field 04D.
W70-00368

FENCES ON OVERFLOWED LANDS.
Ind Ann Stat secs 30-501 thru 30-512 (1969).

Descriptors: *Indiana, *Land tenure, *Overland flow, *Overflow, Legislation, Cost sharing, Cost-benefit ratio, Administrative agencies, Streams, Lakes, Ponds, Marshes, Surveys, Assessments, Compensation, Damages.
Identifiers: *Fences, *Viewers.

The owners of land used for purposes of cultivation and situated upon or near any stream or watercourse, lake, pond, or marsh, and subject to overflow therefrom, may petition for permission to inclose such area under one general fence. Viewers shall be appointed to inspect the land to apportion the cost of the fence among the owners. Such viewers shall submit a report of their assessment to the county commissioners. Provisions are made for the collection of the assessments. The viewers may employ a surveyor if necessary. If rails from the fence are carried away by the overflow of high water, the owner may recover the rails from the property of another if he does so within 60 days. The county recorder shall keep a record of marks on the rails and plank-fencing. Anyone who has recorded his mark and has his rails removed by high water may recover his rails at any time of the year, provided that he pays all damage done to growing grain on the land from which such rails or plank-fencing are to be removed. (Heckerling-Florida)
W70-00369

FISH AND GAME (LICENSES).

Ind Ann Stat secs 11-1401 thru 11-1406 (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Permits, *Regulation, Legislation, Administration, Recreation, Water sports, State governments, Fish, Sport fishing, Trout.
Identifiers: *Penalties (Civil), Licenses.

Hunting, fishing, and trapping licenses are required in Indiana. Upon payment of the applicable license fee, a specified amount of which is retained by the issuing officer, the license is issued. Any resident owner of farmland and his family may hunt and fish on land belonging to that owner without a license. Distinctions are drawn between residents and non-residents with regard to licensing fees. (Moulder-Florida)
W70-00370

JOINT CONSTRUCTION OF WATER SUPPLY.
For primary bibliographic entry see Field 03D.
W70-00371

HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).

225 So 2d 638-642 (Ct App La 1969).

Descriptors: *Riparian rights, *Louisiana, *Real property, *Damages, Legal aspects, Judicial decisions, Land, Land tenure, Mississippi River, Relative rights, Rivers, Riparian land.
Identifiers: *Batture land.

Plaintiff brought this action to recover damages from trespass to his land. Defendants claimed ownership of plaintiff's land by title and adverse possession. The disputed land was a strip of batture land lying between the Mississippi River and a public road. Plaintiff's title was based on a reservation in a previous conveyance; the court ruled that the reservation was valid, that plaintiff's title was superior, and that plaintiff was entitled to recover damages. The court stated that a conveyance of property along a river conveys the riparian rights appurtenant thereto, therefore a reservation of land along a river reserves those riparian rights. (Darragh-Florida)
W70-00372

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00373

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00374

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00375

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00376

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00377

COMMERCIAL FISHING AND MUSSEL LICENSES.

Ind Ann Stat secs 11-1412 thru 11-1419 (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Permits, *Commercial fishing, *Regulation, Administration, Mussels, Fish, Fishing, Water sports, Recreation, Nets, Fishing gear, Mollusks, Marine animals, Lake Michigan, Legal aspects.
Identifiers: *Licenses.

Indiana requires licenses for commercial fishing. Regulations concerning resident and non-resident commercial fishing licenses and fees applicable to Lake Michigan are provided. Also included are regulations concerning license and fee requirements for persons fishing the Wabash River where it forms a common boundary between Indiana and Illinois as well as where it flows within Illinois. License provisions and fees for residents and non-residents who take mussels or mussel shells are also provided. (Moulder-Florida)
W70-00378

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).
For primary bibliographic entry see Field 06G.
W70-00379

OHIO VALLEY COMPACT.
For primary bibliographic entry see Field 06B.
W70-00380

STREAMS AND WATERS.
For primary bibliographic entry see Field 05G.
W70-00381

CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
For primary bibliographic entry see Field 05E.
W70-00382

ANGLING LAWS.

Iowa Code Ann secs 109.67, 109.70-109.86 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Freshwater fish, *Fishing, *Fishing gear, Frogs, Fish, Sport fish, Fish conservation, Fish farming, Fish management, Fish stocking, Farm ponds, Commercial fishing, Baits, Nets, Minnows, Bait fishing, Mississippi River, Missouri River, Artificial watercourses, Legislation, Legal aspects, Regulation.
Identifiers: Throw lines, Trot lines, Fish limits.

Open seasons, catch limits, possession limits, and minimum lengths or weights of various species of fish are set out in tables. Fish may be taken with hook, line and bait only, and limits are specified for number of lines and hooks per line. Limits are placed on the number, size, and areas of use of trot

and throw lines. Each trot line must be identified, must have one end visibly set from shore, and cannot be entirely across a waterbody. Unlawful methods of taking fish are listed. Except to provide breeding stock for farm ponds, the State Conservation Commission may not stock private waters unless such waters are open to the public for fishing. Lawful dimensions for minnow nets are provided. A license is required for taking minnows for commercial purposes. Minnows cannot be taken from trout streams, and the Commission may designate other areas as protected. Minnows cannot be taken outside the state for sale. The use of specified bait is prohibited. (Douberley-Florida)
W70-00383

POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.

SC Code Ann secs 70-171 thru 70-177 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Reservoirs, *Flooding, Legal aspects, Lakes, Ponds, Legislation, Private rights, Relative rights, Water law, Reservoir operation, Artificial watercourses.
Identifiers: *Cemetaries, *Burial grounds.

Any water-power or reservoir company proposing to create an artificial lake, pond, or reservoir encroaching upon any cemetery or burial ground shall publish notice and follow procedures outlined in this act for re-location or other disposition of bodies prior to flooding the burial ground. (Harris-Florida)
W70-00384

FISH AND GAME.

NH Rev Stat Ann sec 211:46-211:64 (1964), as amended, (Supp 1967).

Descriptors: *Fish, *Fishing, *New Hampshire, *Regulation, Fish reproduction, Fish conservation, Legislation, United States, Administrative agencies, Trawling, Nets, Fish management, Commercial fishing, Permits, Fisheries, Planning, Shellfish.

Seasons and limits may be established for the taking of certain varieties of fish. The use of seines, nets, or weirs is forbidden and trawling for codfish is outlawed. Only residents of the state who have a permit may take shellfish in designated areas. Marine species can be regulated and motor vehicles are prohibited from driving on clam flats. The Governor may appoint an advisory committee on shore fisheries, which will suggest plans for propagation and regulation of the taking of shellfish and shore fish to the Department of Game and Fish. The Director of the Department of Game and Fish shall cooperate with the United States Department of the Interior in carrying out congressional projects concerning fish and wildlife. (Darragh-Florida)
W70-00385

OIL AND GAS WELLS--DECLARATION OF POLICY.
For primary bibliographic entry see Field 05G.
W70-00386

ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00387

RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
For primary bibliographic entry see Field 04A.
W70-00388

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
For primary bibliographic entry see Field 04A.
W70-00389

DRAINAGE DISTRICTS EMBRACING PART OR WHOLE OF CITY OR TOWN.
For primary bibliographic entry see Field 04A.
W70-00390

OHIO RIVER VALLEY WATER SANITATION COMPACT.
For primary bibliographic entry see Field 05G.
W70-00391

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
For primary bibliographic entry see Field 04D.
W70-00392

SENECA PORT DISTRICT.
For primary bibliographic entry see Field 04A.
W70-00393

OIL, GAS, AND SALT WATER WELLS.
For primary bibliographic entry see Field 05G.
W70-00394

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00395

PLANS OF RECLAMATION.
For primary bibliographic entry see Field 04A.
W70-00396

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
For primary bibliographic entry see Field 05G.
W70-00397

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
For primary bibliographic entry see Field 04A.
W70-00398

SANITATION DISTRICTS.
For primary bibliographic entry see Field 05G.
W70-00399

SANITATION DISTRICTS.
For primary bibliographic entry see Field 05G.
W70-00400

SANITATION DISTRICTS.
For primary bibliographic entry see Field 05G.
W70-00401

SANITATION DISTRICTS.
For primary bibliographic entry see Field 05G.
W70-00402

SOIL AND WATER CONSERVATION DISTRICTS LAW.
For primary bibliographic entry see Field 03D.
W70-00403

SOIL AND WATER CONSERVATION COMMISSION.
For primary bibliographic entry see Field 04A.
W70-00404

FLOOD PREVENTION.
For primary bibliographic entry see Field 04A.
W70-00405

ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
For primary bibliographic entry see Field 04A.
W70-00406

ARKANSAS FORESTRY COMMISSION.
For primary bibliographic entry see Field 04D.
W70-00407

ORGANIZATION OF DRAINAGE DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00408

SPORT FISHING.
Conn Gen Stats Ann secs 26-108 to 26-141 (1960), as amended, (Supp 1969).

Descriptors: *Delaware, *Sport fish, *Fish conservation, *Fish management, Legislation, Commercial fish, Fisheries, Fish hatcheries, Fishing, Fish barriers, Fish passages, Fish stocking, Regulation, Baits, Bait fishing, Reservoirs, Bodies of water, Administrative agencies, Poisons, Controlled drainage, Bridges, Seasonal, Legal aspects.
Identifiers: Fishing rights, Demarcation (Streams).

The State Board of Fisheries and Game determines dividing lines between inland waters and marine districts and lines dividing lakes from running streams. The Board regulates fishing and taking of bait in all inland waters and may issue regulations relating thereto that, among other things, establish seasons, size limits, legal taking methods, restricted areas, control boats, access areas, and trespass limits from the banks of waterbodies. Certain species of fish may not be sold commercially, and taking fish by means of explosives, drugs, and poisons is prohibited. Specific provisions cover limitations on specific fish species, use of certain waterbodies, and prohibited fishing methods, and penalties are provided for offenses, to include forfeiture of equipment. Regulations provide for stocking fish in public and private waters and for the use of these stocked areas. Bait species may not be taken for removal from the state, and restrictions are imposed on introduction of new bait species into the state. Provisions cover construction of fishways over dams and prohibition of commercial fishing near fishways. The Board also engages in fisheries management with power to operate necessary facilities. (Douberley-Florida)
W70-00409

SPORT FISHING.

Conn Gen Stats Ann secs 26-108 to 26-117 (1960), as amended, (Supp 1969).

Descriptors: *Delaware, *Sport fish, *Fish conservation, *Fish management, Legislation, Fish, Commercial fish, Freshwater fish, Fisheries, Fish hatcheries, Fishing, Regulation, Bodies of water, Permits, Administrative agencies, Watercourses (Legal), Legal aspects.
Identifiers: Demarcation (Streams).

Upon notice and hearing, the State Board of Fisheries and Game may determine lines in streams and bays dividing inland waters and marine districts. It also establishes demarcation lines dividing lakes or ponds from streams flowing in or out of them. The Board may regulate fishing and taking of bait in all inland waters, including regulations establishing seasons and special open hours, legal methods of taking fish, legal lenghts and limits, restricted fishing areas, permit requirements, and rules for use of power craft. It may also designate areas exclusively for women, children, or handicapped persons, provide for entrance and exit to waterbodies, establish trepass limits from banks, and prohibit trespassing, damage, swimming, picnicking, parking, and litter-

ing on property under control of the Board. Commercial use of certain species of fish is prohibited; otherwise this chapter does not apply to commercial fishing nor may its provisions interfere with the public water supply. Penalties for violations are provided, and each fish illegally taken is a separate offense. The Board engages in fisheries management and is authorized to spend federal funds for fish and pond improvement facilities. (Douberley-Florida)
W70-00410

SPORT FISHING.

Conn Gen Stats Ann secs 26-118 to 26-137 (1960), as amended, (Supp 1969).

Descriptors: *Delaware, *Sport fish, *Fish conservation, *Fish management,.Legislation, Fish, Commercial fish, Freshwater fish, Fisheries, Fish hatcheries, Fishing, Fish barriers, Engineering structures, Dams, Fish passages, Fish ladders, Fish stocking, Regulation, Ice fishing, Farm ponds, Reservoirs, Bait fishing, Permits, Administrative agencies, Poisons, Toxins, Striped bass, Carp, Legal aspects.
Identifiers: Licensing.

Written permission must be obtained before fishing in reservoirs used for domestic water supplies. Use of explosives, drugs, and poisons for taking fish is prohibited. Specific limitations are placed on taking striped bass, on fishing in certain ponds, and through the ice. It is unlawful to take bait for transportation out of the state, except for hatcheries or private waterbodies, and permits must be obtained for introducing carp and goldfish into the state. The state may not stock areas in which the owner will not allow public fishing, except by sale of surplus stocks to the owner. If private waters are registered, the owner may take any fish without a license. Permission must be obtained before any stocking is done, and the Board of Fisheries and Game may regulate privately stocked waters upon request. Boats, tackle, and implements may be forfeited for violation of any of these rules and regulations. Obstructions to the passage of fish are prohibited except to prevent escape of stocked fish and to prevent fish from entering machinery flumes. Individuals may petition to have a fishway constructed on an artificial obstruction, and commercial fishing is prohibited near a dam or fishway. (Douberley-Florida)
W70-00411

SPORT FISHING.

Conn Gen Stats Ann secs 26-138 to 26-141 (1960), as amended, (Supp 1969).

Descriptors: *Delaware, *Fish conservation, *Fish management, *Drainage practices, Legislation, Fish, Commercial fish, Freshwater fish, Fishing, Regulation, Administrative agencies, Controlled drainage, Drainage effects, Bridges, Legal aspects.
Identifiers: *Fishing rights, Penalties (Criminal).

A waterbody may not be drained for the taking of fish. Any draining that might endanger fish life must be reported to the Director of the State Board of Fisheries and Game prior to draining. Fishing rights in streams crossing highways are in the abutting owner, condemnee, or grantor, unless fishing rights have been otherwise transferred and compensated for. The Highway Commissioner has full authority to regulate bridge fishing. Unless otherwise provided, maximum penalty for violating this act is $100 and 30 days imprisonment for each offense. (Douberley-Florida)
W70-00412

6G. Ecologic Impact of Water Development

ECOLOGICAL EFFECTS OF WEATHER MODIFICATION: A PROBLEM ANALYSIS.
Michigan Univ., Ann Arbor. Dept. of Resource Planning and Conservation.
Charles F. Cooper, and William C. Jolly.
University of Michigan, School of Natural Resources Report, May 1969. 160 p, 140 ref. 14-06-D-6576 (Bureau of Reclamation, Office of Atmospheric Water Resources).

Descriptors: *Weather modification, *Ecology, Wildlife, Aquatic habitats, Silver iodide, Insect invasion, Weeds, Plant diseases, Monitoring.

If deliberate modification of weather can be achieved, the structure of plant and animal communities may be altered through shifts in rates of reproduction, growth, and mortality of weather sensitive species. Weather modification may interact with other ecological stresses such as air pollution and pesticide application to produce changes greater than the sum of the individual effects. The argument is rejected that because the change anticipated from weather modification is smaller than the normal variability of weather, weather modification will have little or no biological effect. Catastrophic outbreaks of weeds or insect pests are unlikely as a result of weather modification, but not impossible. Big game animals could be adversely affected if snow accumulation is significantly increased on winter range. Somewhat different effects are anticipated in semiarid and in humid regions. There does not appear to be an immediate serious threat of environmental contamination from silver iodide or other seeding agents. If a global environmental monitoring system is developed, it should deal with all forms of environmental change, not weather modification alone. No research dealing specifically with ecological effects of weather modification has yet been reported. Institutional arrangements may have to be altered to obtain research support in this area. The report includes sections of anticipated kinds of weather modification; effects in semiarid climates and in humid climates; pests and diseases; direct effects of seeding agents; biology of lakes and streams; fog, hail, lightning, and hurricane modification; environmental monitoring programs; inferences from ecological theory; recommended research; and recommended pre-modification field surveys.
W70-00140

CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-00270

THE WATER RESOURCE,
Department of the Interior, Washington, D.C.
Luna B. Leopold, and Seymour Tilson.
International Science and Technology, p 24-34, July 1966. 13 fig.

Descriptors: *Water resources, Water Pollution, Diseases, Sewage, Industries, Ethics, Water management (Applied), Precipitation (Atmospheric), Irrigation efficiency, Hydrologic cycle, Groundwater, Lakes, Ponds, Snow, Equilibrium, Dams, Water table, Wells, Aquifers, Arid lands, Grasslands, Forests, Permeability, Wetlands, Environmental engineering, Pollutants, Water purification, Bacteria, Biochemical oxygen demand, Eutrophication, Soil moisture, Statistical models, Electrical networks, Simulation analysis, Monitoring.
Identifiers: Cholera, Dysentery, Hepatitis, Typhoid, Esthetics, Quality, Indus River plain (West Pakistan), Impermeable surfaces, Hydrologic flow system, Degradable wastes, Ruhr Valley (Germany), Taft Sanitary Engineering Center, Hydrologic-ecologic foreknowledge, Round Lake (Fla), Arkansas River, Platte-Big Blue River, El Paso (Tex), Kentucky River, Non-degradable wastes.

Total water in rivers and ground is ample for future needs; regional shortages can be alleviated by some optimum combination of pollution control, water reprocessing and reuse, and groundwater development; water deficient regions can benefit by river diversion. However, whether pollution problems can be cured at this point is doubtful. Intervention of man in natural equilibria--physical, ecological, and hydrological--has created an entirely new hydrologic system which cannot reach its equilibrium while man continues to alter its parameters. The precise effects of these changes are not known because population requirements and varied wastes are so widespread that basic hydrologic data have become mere historical records. The lack of hydrologic data can result in critical problems as schemes, of continental proportions, for rerouting water from one drainage basin to another come under scrutiny. Water management studies are also seriously deficient since no method exists for assignment of meaningful numbers to esthetic and ethical uses. Stochastic models describing overall environmental behavior, electrical networks as analog models for groundwater systems, and simulation methods based on digital computer are trends in hydrology. The technical community should keep its ears attuned to river murmurs as well as to the whine of turbines. (Jones-Wisconsin)
W70-00272

BIOLOGY AND ECOLOGY OF NITROGEN.
California Univ., Davis.
For primary bibliographic entry see Field 02K.
W70-00277

PROBLEMS OF THE PROTECTION OF WATER IN CONNECTION WITH THE BUILDING OF WATER-POWER PLANTS (IN GERMAN),
For primary bibliographic entry see Field 05G.
W70-00292

THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
North Dakota Univ., Grand Forks.
For primary bibliographic entry see Field 05C.
W70-00311

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).

219 SW2d 948-953 (Ark 1949).

Descriptors: *Arkansas, *Wildlife conservation, *Eminent domain, *Fish conservation, Remedies, State governments, Condemnation, Reservoirs, Dams, Pipelines, Easements, Conservation, Fish, Wildlife, Judicial decisions, Legal aspects, Administrative agencies, Compensation.

The State Game and Fish Commission sought to condemn lands for the creation of a reservoir for a fish and game reserve. Defendant landowners opposed the condemnation alleging that it was not authorized for the purposes contemplated by the legislature and that the land was already devoted to a public use in that defendant's pipeline served the public. The defendants appealed from an adverse ruling in the chancery court. The supreme court affirmed this decision. It found that the Arkansas constitution granted the Fish and Game Commission broad discretion in determining how wildlife should be conserved and that it had not been established that the Commission went beyond this. The court agreed that land which had been devoted to a public use could not be subjected to subsequent condemnation which would impair its first use. However, here the pipeline could have been reasonably maintained under the reservoir or relocated at a cost not incompatible with the Com-

mission's objectives. The inconvenience and cost to the pipeline company, while it required compensation, was not sufficient to justify injunctive relief. (Gabrielson-Florida)
W70-00379

07. RESOURCES DATA

7B. Data Acquisition

THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
International Atomic Energy Agency, Vienna (Austria); and Ministry of Natural Resources, Nairobi (Kenya). Dept. of Water Development.
T. Florkowski, T. G. Davis, B. Wallander, and D. R. L. Prabhakar.
J Hydrol, Vol 8, No 3, p 249-264, July 1969. 16 p, 5 fig, 2 tab, 11 ref.

Descriptors: *Flow measurement, *Tracers, Turbulent flow, Stream gages, Gaging stations, Tracking techniques, Radioisotopes, Tritium, On-site tests.
Identifiers: Isotope dilution flow measurement.

Use of tritiated water as a tracer for measurement of flow rate in turbulent rivers offers a promising technique for high flows where other methods are not feasible. Examples of application are given from flow gaging in River Tana where flows from 100 to over 500 cu m/sec have been measured and compared with rating curves. Tritium technique proved to be accurate, easy to use in remote areas and applicable for high flow rates. (Knapp-USGS)
W70-00035

THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
Technion - Israel Inst. of Tech., Haifa. Hydraulic Lab.
M. H. Diskin.
J Hydrol, Vol 8, No 3, p 323-335, Jul 1969. 13 p, 5 fig, 2 tab, 2 ref, 1 append.

Descriptors: *Rainfall, *Runoff forecasting, *Probability, *Monte Carlo method, *Computer programs, Approximation method, Estimating, Rainfall disposition.
Identifiers: Thiessen polygon method.

A method of computation and a digital computer program for the determination of Thiessen weights of rainfall measuring stations is presented as a substitute to the graphical method commonly used for this purpose. The method is based on a Monte Carlo procedure for the estimation of the size of sub-areas of a rectangular area whereby the relative size of any sub-area is given by the limit as the number of points is increased of the ratio of random points falling inside the sub-area to the total number if such points generaged uniformly in the rectangular. An example of the use of the proposed method is also presented and the results obtained are discussed. (Knapp-USGS)
W70-00039

AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
Geological Survey, Helena, Mont.; and Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 02F.
W70-00209

SEDIMENT MEASUREMENT TECHNIQUES: A. FLUVIAL SEDIMENT,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-00214

SEDIMENT MEASUREMENT TECHNIQUES: F. LABORATORY PROCEDURES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-00215

TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
Miami Univ., Fla. Inst. of Marine Sciences.
For primary bibliographic entry see Field 02K.
W70-00224

THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 05A.
W70-00305

A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
Hydrogeological Enterprise, Warsaw (Poland).
Janusz Niemczynowicz, and Edward Fraczek.
Nukleonika, Vol 12, No 11, p 62-66, 1967. 5 p, 3 fig, 3 ref.

Descriptors: Groundwater, *Groundwater flow, *Groundwater movement, *Wells, Tracers, Radioisotopes, X-rays, *Boreholes, Water wells, *Drill holes, Filtration, Infiltration, Radiation measurement, *Radioactivity techniques, *Orientation, Direction finding.
Identifiers: Poland, Radiation detectors, *Radioactive tracers, Probes (Instruments), Foreign products, Gyro compasses, Radiography.

The radiometric single-hole method determines the direction of filtration in a drill hole by introducing a radioactive isotope into the water. The radioisotope is deposited by the flowing water on the filter and in the surrounding ground; absorption of the radioactive isotope is greatest in the direction of flow and least in the opposite direction. The center of greatest concentration is located with a directional radiation detector. The measuring instrument must be oriented to determine azimuths. A new probe has been developed for finding the direction of filtration. Radiation is detected on X-ray film; a gyroscopic direction indicator is used to orient the film. Using X-ray film has eliminated the need for intricate electronic equipment in the field. The gyroscopic direction indicator is suitable for measuring depths to 300 m. (USBR)
W70-00331

COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
Geological Survey, Washington, D.C.
B. F. Grossling.
Geophys, Vol 34, No 2, p 249-254, Apr 1969. 6 p, 7 ref.

Descriptors: *Color, Data processing, Data reduction, Vision, Optical properties, *Optical instruments, Photographic equipment, *Photographs, Photography, Maps, *Aerial photography, *Geologic investigations, Geology, Geophysics.
Identifiers: *Data presentation, Optical analysis, Transparency, Optical measurements, *Photographic analysis, Visual aids.

Color mimicry is proposed as a method for revealing more information in a picture than is otherwise obtainable from an ordinary color or black and white photograph. The technique consists of preparing a color synthesis of 2 or 3 pictures of the same object or scene. Transparencies of the pictures are projected and superimposed on a screen, using a separate projector for each transparency. Various color effects are produced by using different combinations of white light and color filters in the projectors, adjusting the relative intensities of the projector lights, and deliberate misalinement of the projected images. The colors used in the mimicry need have nothing to do with any actual color sensation in the original data. The pictures may be taken from the visual or other bands of the electromagnetic spectrum, or even need not be photographs. Gray level representations of 2-dimensional fields of abstract data or data physically different than radiation can also be mimicked in color. (USBR)
W70-00332

THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
H. S. H. Thomas, and W. H. Ward.
Bldg Res Sta Curr Pap, CP 14/69, May 1969. 15 p, 9 fig, 1 tab, 21 ref.

Descriptors: *Earth pressure, Effective stress, *Pressure gages, Earth dams, *Pressure measuring instruments, *Instrumentation, Soil mechanics, Calibrations, Foreign research, Hysteresis, Field tests, Bibliographies.
Identifiers: *Pressure cells, Arching, Arch action, Balderhead Dam (Gt Brit), Building Research Sta, DSIR, *Vibrating-wire strain gage.

Design and construction of a sturdy but accurate total earth pressure cell are described. Results from a group of cells buried in the clay core of an earthfill dam demonstrate the consistent performance and reliability of the cells over a 5-yr period. Modifying the cell permits a twofold use: measurement of soil pressure on a rigid surface and stress within a soil mass. The buried cell is 11 in. in diameter and 1-1/2 in. thick. The sensitive area on the cell face is 34% of the total area and the diameter/deflection ratio is slightly over 2000. When installed on a rigid surface, the cell is set in a ring of cold-setting rubber to prevent distortion by flexure of the structure. Models with maximum ranges of 100, 200, and 300 psi are being built. Vertical pressure readings during the last stages of construction of the dam are low compared to values obtained from an elastic solution. This is the result of the core arching between the shoulders. When the reservoir was filled, an increase in the ratio between the horizontal and the vertical effective stress and a rotation of the axes of principal stress were observed. (USBR)
W70-00337

7C. Evaluation, Processing and Publication

DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
Ministry of Irrigation and Power, New Delhi (India).
For primary bibliographic entry see Field 02E.
W70-00038

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02A.
W70-00054

THE MECHANICS OF SURFACE RUNOFF,
Florida Univ., Gainesville. Dept. of Bioenvironmental Engineering.
For primary bibliographic entry see Field 02E.
W70-00055

THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering; and Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02A.
W70-00056

WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1968.
Wyoming Univ., Laramie.

Wyoming Water Resources Research Institute, Water Resources Series No. 14, June 1969. 367 p, 179 tab, 179 fig. OWRR Report A-999-WYO.

Descriptors: *Data processing, *Climatological data.

Temperature and relative humidity data that have been reduced from hygrothermograph charts and non-recording precipitation gages are presented in tabular form. Four readings per day at 0600, 1200, 1800 and 2400 hours and the maximum and minimum are presented. The mean, maximum, and minimum temperatures are also shown graphically. The reduced data are transferred to punch cards for computation and tabulating by the University of Wyoming's digital computer. The card format and computer program were presented in Wyo. WRRI Water Resources Series No. 8.
W70-00138

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02F.
W70-00204

AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
Department of National Hydrology (France).
For primary bibliographic entry see Field 02J.
W70-00250

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02E.
W70-00251

GENERATION OF MONTHLY STREAM-FLOW DATA,
Ministry of Works, Wellington (New Zealand). Civil Div.
For primary bibliographic entry see Field 02E.
W70-00255

MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 02G.
W70-00307

08. ENGINEERING WORKS

8A. Structures

CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Robert G. Cox, and Yen-Hsi Chu.
Corps Eng Rep No H-69-8, Sept 1969. 31 p, 17 ref.

Descriptors: *Hydraulic models, *Outlet works, *Hydraulic design, Model studies, Water structure, Flow resistance, Laboratory tests, Flow rates, Flood control.
Identifiers: *Pressure distribution, Upstream face geometry.

This report summarizes a study of inlet pressures measured in nine hydraulic models and two laboratory investigations of entrance designs for flood control outlet works. The experimental data are examined to determine the effects of upstream face geometry, guide piers, and bulkhead and gate slots. Both two-dimensional and three-dimensional flow inlets are considered and compared with free-streamline inlets. The results are presented graphically in terms of dimensionless pressure drop coefficients for use in estimating pressure conditions to be expected in design practice. Design criteria are recommended. (Lang-USGS)
W70-00002

RESUME OF THE REPORT ON THE FAILURES,
Central Electricity Generating Board, London (England). Generation Design Dept.
I. W. Hannah.
Natural Draught Cooling Towers - Ferrybridge and After, Proceedings of the Conference held at the Institution of Civil Engineers (June 12, 1967) p 1-7, 1967. 5 fig, 2 tab, 7 ref.

Descriptors: *Cooling tower, *Design criteria, *Structural design, Thermal powerplants.
Identifiers: *Ferrybridge Power Station.

The final report is summarized which the Committee of Inquiry produced in August 1966. Abstracts from the report are used wherever possible and the paper concludes with the full recommendations of the Committee, since it is probable that much of the design and development work on cooling towers to be undertaken in the next few years, will be guided by these recommendations. The main criticisms were: (a) use of a 1 min maximum mean wind speed for the design loading; (b) reinforcement proportioned without sufficient margins to cover uncertainties in wind loading and their dynamic effects; (c) sensitivity of design to minor changes in pressure coefficient distribution was not appreciated. Specification and design of the towers were discussed along with meteorological conditions, mode of failure, and research investigations. (Ross-Vanderbilt)
W70-00143

STRUCTURAL DESIGN PHILOSOPHY,
University Coll., London (England). Dept. of Civil Engineering.
A. H. Chilver.
Natural Draught Cooling Towers - Ferrybridge and After, Proceedings of the Conference held at the Institution of Civil Engineers (June 12, 1967) p 9-13, 1967. 3 fig, 7 ref.

Descriptors: *Cooling tower, *Wind pressure, *Structural design, Elastic theory.
Identifiers: Wind loading, Critical dynamic pressure, Ferrybridge cooling tower.

An attempt is made to show the difficulties in formulating a structural design philosophy for hyperboloidal cooling towers. The problem is complicated by the fact that the actual state of wind loading of a cooling tower is unsteady and random in nature. The unsteadiness appears to be accentuated in groups of towers. It is suggested that an acceptably low rate of structural failures, of the order of one group of towers, within 20 similar groups, once in 25 years, implies the design of towers to collapse at wind speeds of about 125 miles/hr. This probably corresponds to an elastic design wind speed of about 100 miles/hr. Some special problems of the structural design of hyperboloidal cooling towers are considered briefly, including the importance of shell-bending effects, buckling under wind loading and resonant vibrations. Reinforced concrete towers may become prone to static or dynamic instability because of extensive vertical cracking; it is suggested that some form of circumferential prestressing may be necessary to overcome the weakening effects of vertical cracks. (Ross-Vanderbilt)
W70-00144

CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
Central Electricity Generating Board, London (England).
W. A. Fitzherbert.
Natural Draught Cooling Towers - Ferrybridge and After, Proceedings of the Conference held at the Institution of Civil Engineers (June 12, 1967), p 45-49, 1967. 3 fig, 1 tab.

Descriptors: *Cooling tower, *Design standards, *Structural design.
Identifiers: *Ferrybridge power station, *CEGB stations, Meridional reinforcement in the shell, Notional tensile strength, Pressure coefficient specifications.

The Ferrybridge Report concluded that the basic cause of collapse of the completed cooling towers was due to errors in specification and design rather than to faulty construction and pointed out that these faults may well have been introduced at other contemporary stations. Subsequent analysis has confirmed this and the paper discusses the practical problems of introducing adequate factors of safety in these existing structures. Preliminary investigations revealed a pronounced weakness in the provision of meridional reinforcement in the shell. The collapsed shells were to be rebuilt with 8 inch walls having a similar total amount of reinforcement to that used in the strengthened shells, divided between the faces to increase local bending stiffness. (Ross-Vanderbilt)
W70-00145

THE ROUND TURBULENT JET IN A CROSS WIND,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
J. F. Keffer, and W. D. Baines.
Journal of Fluid Mechanics, Vol 15, Part 4, p 481-496, Apr 1963. 13 fig, 12 ref.

Descriptors: *Winds, *Jets, *Model studies, Flow profiles, Turbulent flow.
Identifiers: *Entrainment, *Entrainment coefficient.

Model studies of the flow of a jet normal to a uniform, steady cross-wind were made in a low speed air tunnel. Velocity ratios (jet to ambient) were varied from 2 to 10. Experimental results show that for various jet strengths the position of the jet in space, when stretched by the ratio of jet to cross-wind momenta, is described by a single function. Exceptions exist at very low velocity ratios where a shift of the potential core is evident. A natural system of axes is used to define important directions of the flow. The integrated equation of motion along the primary jet flow direction is made dimensionless after the general method of Morton (1961) and a virtual source is defined by the flow. It is shown that a single functional behavior of the axial jet velocity ratios if the jet is considered to originate from this source. Lateral velocity profiles show a similarity when scaled by appropriate lengths and velocities but true self-preservation is not attained. (Guerrero-Vanderbilt)
W70-00154

HYPERBOLIC COOLING TOWERS,
Leslie (Robert) and Partners.
W. M. Stern.
Power, Vol 111, p 59-62, Feb 1967.

Descriptors: *Cooling towers, Structural design, Wind pressure.
Identifiers: *Hyperbolic cooling towers, *Economics of cooling towers, Exhaust effluent, Tower spacing, Wind-loading.

When constructing natural draft cooling towers, especially the immense hyperbolic towers, very severe structural requirements must be met. Layout of multiple towers, economics, climate and wind loading, height of exhaust, packing or fill arrangements to dimension the ultimate diameter of

the tower, or packless towers, spray equipment, availability of water and construction materials are all factors to be considered. Now commonly constructed are the hyperbolic concrete-shell cooling towers. Climbing scaffolds and slipforms are used in their construction. (Rietveld-Vanderbilt)
W70-00291

PHILOSOPHY OF FAILURE,
Imperial Coll. of Science and Technology, London (England). Dept. of Engineering.
A. L. L. Baker.
Natural Draught Cooling Towers - Ferrybridge and After, Proceedings of the Conference held at the Institution of Civil Engineers (June 12, 1967) p 15-17, 1967. 1 fig, 1 tab, 2 ref.

Descriptors: *Cooling towers, *Structural analysis, Concrete construction, Wind pressure.
Identifiers: *Ferrybridge cooling tower, Buckling resistance, Tower shells, Aerodynamic data.

The paper points to the large differences between the buckling resistance of cooling-tower shells and their ability to oppose uplift forces, and indicates the importance of increasing the latter. Preserving the shell structural stiffness by correct arrangement of the necessary additional reinforcement is also considered essential. From regarding the Ferrybridge collapse as a massive full-scale experiment, a design philosophy compatible with the European Concrete Committee limit state approach is outlined. The significance of the present lack of reliable aerodynamic data and the remarkable sensitivity of tower shells to variations in loading are clearly described. (Ross-Vanderbilt)
W70-00294

MATHEMATICAL ASPECTS,
National Physical Lab., Teddington (England).
E. L. Albasiny, and D. W. Martin.
Natural Draught Cooling Towers-Ferrybridge and After, proceedings of the conference held at the Institution of Civil Engineers (June 12, 1967), p 31-35, 1967. 6 fig, 3 ref.

Descriptors: *Cooling towers, *Mathematical studies, *Structural analysis, Wind pressure.
Identifiers: Bending solutions, Membrane solutions, Base distortion effects, Elastic equilibrium, Ferrybridge cooling tower.

Numerical solutions have been obtained to the complete linear equilibrium equations for a single hyperbolic cooling tower shell subjected to a steady wind loading. The Authors' published results for a typical tower show (a) that the bending solutions in the main body of the shell are unaffected by the additional support conditions assumed at the base; (b) that the bending and membrane solutions for the direct forces and displacements are in good agreement and (c) that maximum moment values occur near the throat of the tower, apart from possible edge effects, and vary roughly as the square of the shell thickness. The analysis is extended here by permitting tangential displacements at the base of the shell which are proportional to the net horizontal edge-force and to the vertical stress-resultant. It is demonstrated that the bending stresses can be substantially increased by these flexible support conditions, whereas the direct stress-resultants are relatively unaffected. It is further shown that the effect of a local subsidence at the base of the shell is to induce bending stresses. (Ross-Vanderbilt)
W70-00295

VIBRATION OF COOLING-TOWER SHELLS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
J. J. Williams.
Natural Draught Cooling Towers-Ferrybridge and After, proceedings of the conference held at the Institute of Civil Engineers (June 12, 1967), p 37-43, 1967. 14 fig, 11 ref.

Descriptors: *Cooling towers, *Wind pressure, *Model testing, *Vibrations.
Identifiers: Ferrybridge cooling towers, Hyperbolic cooling tower, Cone-toroid cooling tower, Dynamic stiffness, Natural frequencies.

Theoretical and experimental investigations of the frequency response of hyperbolic and cone-toroid cooling-tower shells have shown that the lowest natural frequencies are associated with a circumferential wave number of 4 or 5, and an axial wave number of 2 (in normal displacement). Comparison of the lowest natural frequencies of a cone-toroid and a corresponding hyperbolic shell shows that in general, the frequencies of the hyperboloid are significantly higher. This indicates that meridional curvature is a critical parameter governing the dynamic stiffness of cooling-tower shells. (Ross-Vanderbilt)
W70-00296

SOME AERODYNAMIC PROBLEMS OF GROUPED COOLING TOWERS,
Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
P. R. Owen.
Natural Draught Cooling Towers-Ferrybridge and After, proceedings of the conference held at the Institute of Civil Engineers (June 12, 1967) p 73-78, 1967. 4 fig, 2 tab, 7 ref.

Descriptors: *Cooling towers, *Wind pressure, Flow profiles.
Identifiers: Aerodynamic problems, Ferrybridge cooling tower, Wind shear.

Certain aerodynamic problems of grouped cooling towers are discussed: namely, the tendency of the group to slow-down the approaching wind and to ameliorate the so-called 'channelling effect'; and the possibility, revealed by experiment, of fluctuating forces being magnified in comparison with those on an isolated tower. Some remarks are made about the effect of wind shear on the pressure distribution over a tower and lead to the suggestion that, over the windward face of the tower, the distribution is comparable with that arising from a uniform wind whose velocity is approximately the same as that in the sheared wind at a distance from the ground equal to the height of the tower. (Ross-Vanderbilt)
W70-00298

REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 05D.
W70-00320

STATUS OF BIG COOLING TOWERS,
Marley Co.
E. P. Hansen, and J. J. Parker.
Power Engineering, Vol 71, No 6, p 38-41, May 1967. 3 fig.

Descriptors: *Cooling towers.
Identifiers: *Cross-flow design, Louvers, Towerfill, Drift eliminators, Pressure preservative treatment, Joint connectors.

The article discusses the design and advance material usage of cross-flow design. Problem of icing, entry of debris and deterioration of wood material of towers have been averted by the design and arrangement of today's cross-flow cooling towers. Louvers are constantly flooded with warm water preventing a build up of ice. Asbestos-cement board or reinforced fiberglass is used to eliminate deterioration problems. In design of towerfill, grids of stable, inert material, such as reinforced fiberglass are used to support full splash bars which prevent sagging, and permit fill to expand and contract without warping or cracking. A good design of drift eliminator will operate efficiently with a static pressure drop of less than 0.04 in. (of water) at an airflow rate of 500 fpm and will limit water loss by drift to less than 0.2% of the volume of water being circulated. Fan cylinder is made of glass-reinforced polyester panels, which, when assembled form an ideal eased air inlet and an outlet which provides recovery of discharge air velocity. Single units of hyperbolic natural-draft towers can handle cooling water requirements for units up to 1000 MW. The first hyperbolic unit went on line in 1962 and currently 18 are either completed or contracted for in the United States. (Upadhyaya-Vanderbilt)
W70-00321

A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
For primary bibliographic entry see Field 08E.
W70-00322

STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
California State Dept. of Water Resources, Sacramento.
Leo H. Moir, Jr.
Tech Memo 41, Dep Water Resour, Calif, Jan 1969. 23 p, 18 fig, 2 tab.

Descriptors: *Tunnel linings, *Steel linings, Reinforcing, Stiffening, Fabrication, Handling equipment, Inspection, Transportation, Welding, Weight, Construction, Welded joints, X-ray inspection, Grinding, Installation, *Tunnel construction, Tunnels, California.
Identifiers: Tunnel supports, *California Aqueduct, Stiffeners.

The Angeles Tunnel on the west branch of the California Aqueduct requires reinforcement in places of faulting and minimum overburden. This reinforcement is provided by a circular steel tunnel liner 30 ft in diameter, fabricated underground from 30-ft-long sections known as Cans. Weight of these Cans, including the external stiffener ribs, varied from 53 to 116 tons, and required unusual engineering methods in fabrication, quality control, and placement. The location of the areas of tunnel reinforcement, specifications for the Cans, methods of assembly and fabrication, inspection procedures, transportation, and installation are described. Photographs of fabrication and installation are included. (USBR)
W70-00327

STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND MORROW POINT DAMS,
Bureau of Reclamation, Denver, Colo.
George C. Rouse, William Lockman, and James A. Stubbs.
Res Rep No 16, Bur Reclam, Denver, Colo, 1969. 30 p, 28 fig, 15 ref.

Descriptors: Structural analysis, *Arch dams, *Concrete dams, Analogs, *Model tests, Models, Deflection, Stress analysis, Bibliographies, Loads (Forces), Test procedures, *Structural models, Trial-load method, Safety factors, Dam design, Materials, Mechanical properties, Poisson ratio, Elasticity modulus, Plasters, Strain gages, Temperature.
Identifiers: Glen Canyon Dam, Morrow Point Dam (Colo), Test results.

Techniques used by the Bureau of Reclamation in making structural analyses of Glen Canyon and Morrow Point concrete arch dams by means of models are outlined. Included in the report are: (1) a short history of model testing for concrete dams, (2) preparation of model materials, (3) model construction techniques, (4) loading and testing methods, and (5) comparisons of model stresses and deflections with similar quantities computed by the trial-load method. Model testing techniques used by the Bureau of Reclamation are compared with those developed in Portugal at the Labora-

torio Nacional de Engenharia Civil (LNEC) and in Italy at the Instituto Sperimentale Modelli e Structure (ISMES). (USBR)
W70-00335

COUNTY LINE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00336

COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
City Univ., London (England).
P. Burhouse.
Inst Civ Eng Proc, Vol 43, p 175-194, June 1969. 20 p, 18 fig, 12 tab, 4 ref.

Descriptors: Structural design, *Structural behavior, *Bricks, Foreign research, Test procedures, *Beams (Structural), Loads (Forces), Stress, *Testing, Failures, Reinforced concrete, Deflection, Compression, Youngs modulus, Bending moments, Composite structures, Shear forces, *Walls, Compressive strength.
Identifiers: *Brick masonry, *Loading tests, *Destructive tests, Test results, Foreign testing, Great Britain.

Results are given of experimental work in which simply supported beams carrying brick walls were tested to failure, the load being applied at the top of the wall. The height-to-span ratio of the panel walls was varied and the supporting beams were either of reinforced concrete or cased structural steel joists. Experimental results are compared with results obtained from an analytical treatment of composite walls. Because of the concentration of stress that occurs in the masonry, permissible loads on walls acting in conjunction with their supporting beams should be less than loads specified in the British Standard Code of Practice (CP 111) giving the allowable working load on a brick wall. With a low height-to-span ratio of the wall, composite action may break down because of sliding at the wall-beam interface. (USBR)
W70-00339

THE SLIDING STABILITY OF DAMS,
Harald Link.
Water Power, Vol 21, No 3, 4, 5, p 99-103, 135-139, 172-179, Mar/Apr/May 1969. 18 p, 20 fig, 3 tab, 34 ref.

Descriptors: *Dams, *Shear resistance, *Shear tests, Foundation investigations, Dam design, Dam foundations, Rock mechanics, Deformation, Stability, Hydraulic structures, Core drilling, Concrete technology, Foreign design practices, Safety, Safety factors, Dam failure, Strain gages, Bibliographies, Gravity dams, Buttress dams.
Identifiers: *Sliding resistance, *In situ tests, Great Britain, Test results, Dam stability, Horizontal displacements.

Ensuring the permanent stability of a dam economically requires knowledge of all aspects of the natural characteristics of the underlying foundation area. Slide-proof construction is the foremost requirement, demanding precise knowledge of and sure judgment in subsoil conditions. Dam failures in the past stemmed all too often from lack of shearing or sliding resistance at the base. Review of international literature of the past 25 yr confirms a certain lack of precision in judging sliding stability, but worldwide gains in the knowledge of investigating site conditions in depth, using rock mechanics, have given much valuable experience in the past 10 yr. Present practices for various countries are discussed, with emphasis on shear resistance testing of rock masses at and below the base of a dam. The safety of existing dams can be monitored by careful study of deformation characteristics, recognizing early danger signals. Such measurements should be incorporated into the operational routine, at least during high-water periods. (USBR)
W70-00347

TOWNSHIP LINE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00354

BRIDGES OVER CANALS.
For primary bibliographic entry see Field 04A.
W70-00355

APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
California State Dept. of Water Resources, Sacramento.
Samuel S. Dulberg.
Tech Memo No 35, Dep Water Resour, Calif, Nov 1968. 30 p, 9 photo, 2 dwg.

Descriptors: Tunneling, *Tunnel linings, *Tunnel construction, Faults (Geology), Tunnels, *Gunite, Applizcation methods, Accelerators, Lagging, Concretes, Hardening, Rock bolts, Additives.
Identifiers: *Tunnel supports, Tehachapi-West Branch Proj, Calif.

Shotcrete is a modified, pneumatically applied mortar containing aggregates up to 3/4 in. in size and an accelerator that produces appreciable hardening within 15 min of application and structural strength within hours. Shotcrete was used as the primary support system for approximately 2400 linear ft of Tunnel No 1, and as supplementary support for approximately 900 linear ft of Tunnel No 3 of the Tehachapi-West Branch Project in California. This is the first time that shotcrete has been used as tunnel support in the State of California, and probably the first time in the United States. Shotcrete has been used successfully in Europe since 1957 for tunnel support in bad ground, with and without steel supports and rock bolts. Several problems experienced by the California contractor, including resistance from the miners because of unfamiliarity with this type of tunnel support, are discussed. The method is described and evaluated. Shotcreting can improve the art of tunneling by providing a less expensive and better support system. (USBR)
W70-00356

LEVEE CONSTRUCTION AND MAINTENANCE.
For primary bibliographic entry see Field 04A.
W70-00367

JOINT CONSTRUCTION OF WATER SUPPLY.
For primary bibliographic entry see Field 03D.
W70-00371

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00373

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00374

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00375

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00376

INTERSTATE BRIDGES.
For primary bibliographic entry see Field 04A.
W70-00377

FLOOD PREVENTION.
For primary bibliographic entry see Field 04A.
W70-00405

8B. Hydraulics

CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08A.
W70-00002

A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
California Univ., Berkeley. Hydraulic Engineering Lab.
Edward M. Kuba.
Shore and Beach, Vol 37, No 1, p 49-54, Apr 1969. 6 p, 6 fig, 11 ref.

Descriptors: *Waves (Water), *Landslides, *Model studies, *Hydraulic models, Seiches, Surges, Bays, Estuaries, Lakes, Reservoirs, Floods, Erosion.
Identifiers: Landslide-generated water waves.

A hydraulic model was constructed to study waves generated in bays, estuaries, and reservoirs by landslides. These waves may be hundreds of feet high and cause great loss of life and property, as at the Vaiont Dam, Italy, in 1963. The model is 1 ft wide, 3 ft deep, and 105 ft long. Waves are generated by sliding a block down an incline into the water at a measured speed. Wave height may be predicted when water depth, the horizontal landslide velocity component, and the horizontal component of landslide movement are known. (Knapp-USGS)
W70-00003

HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 02E.
W70-00137

EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
John J. Franco.
Journal of the Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers, Vol 94, p 343-352, Aug 1968. 8 fig, 1 tab, 5 ref.

Descriptors: *Sediment transport, *Water temperature, *Water flow, Stream bed, Bed load.
Identifiers: *Bed movement, Flume study.

Laboratory investigations have indicated that the effects of water temperature on the movement of sediment and on flow in alluvial streams can be appreciable. Some variations noted in flow conditions in the field can be attributed to the effects of water temperature. Information available on the subject has been confusing, or too general to permit the development of definite relations. An investigation undertaken to determine the effects of changes in water temperature on sediment transport, streambed forms, and bed roughness for various types of material is described. The effects of water temperature on bed-load appear to be mostly in the formation of the bed and the bed roughness. (Ross-Vanderbilt)
W70-00142

EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
Department of the Interior, Washington, D.C.
B. R. Colby, and C. H. Scott.
Available from the Superintendent of Document, US Gov't. Printing Office, Washington, D.C., 20402, for $0.25 per copy. Geological Survey Professional Paper 462-G, 25 p, Washington, D.C., 1965. 18 fig, 1 tab, 27 ref.

Descriptors: *Water temperature, *Viscosity, Sediment transport, Alluvial channels, Suspended sediment, Fall velocity, Heated water.
Identifiers: *Temperature effects, Flume flows, Field streams, Laminar sublayer, Viscosity changes, Bed material discharge.

Changes in water temperature and consequent changes in viscosity affect bed-material discharge in complex ways. These ways may be explained in three separate effects. One effect is on the thickness of the laminar sublayer, and this effect is usually the smallest of the three. A second effect is on the vertical distribution of suspended bed material. The third effect is on the bed configuration and, hence, on the resistance to flow. Experimentally defined temperature effects on bed-material discharge usually require classification in terms of the flow characteristics that were kept constant, the variables that were involved in the analysis of the data, and the way in which the data was analyzed. Experimental defined temperature effects on the relation of bed-material discharge to mean velocity for three rivers indicate an average percentage increase of about 75 in bed-material discharge for a decrease of water temperature from 80 deg. to 40 deg. F. High concentrations of fine sediment increase the apparent viscosity of a water-sediment mixture. The addition of 20,000 parts per million of bentonite to distilled water has an effect on viscosity that is about the same as the effect on distilled water of a reduction in water temperature from 60 deg. to 34 deg. F. (Ross-Vanderbilt)
W70-00152

DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
Hydronautics, Inc., Laurel, Md.
Gedeon Dagan.
ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6794, p 1699-1712, Sept 1969. 14 p, 3 fig, 20 ref, append. OWRR Project C-1008.

Descriptors: *Dispersion, *Mathematical studies, Reynolds number, Mixing, Streamflow, Diffusivity, Diffusion, Silts, Turbulent flow, Thermal pollution, Waste dilution.
Identifiers: Dispersivity tensor.

The turbulent mixing of a solute in a streamflow is described with the aid of the dispersivity tensor. In a 2-dimensional pipe or wide channel flow only the radial, or vertical, dispersivity coefficient is significant and is usually determined through the Reynolds analogy. The analogy is extended to a 3-dimensional (i.e., channel of arbitrary section) uniform flow. It is shown that the mixing length theory leads to the representation of the dispersivity tensor in the terms of only 2 distinct coefficients: (1) A coefficient representing mixing normal to isovels which may be found through Reynolds analogy; and (2) a lateral dispersivity coefficient which has to be determined from dispersivity measurements. (Knapp-USGS)
W70-00210

NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-00216

INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
Harry M. Hill, Vajapeyan S. Srinivasan, and Tharakkal E. Unny, Jr.
Invest supported by research grant from Nat Res Council of Canada. ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6770, p 1545-1558, Sept 1969. 14 p, 5 fig, 3 tab, 25 ref, append.

Descriptors: *Open channel flow, *Alluvial channels, *Channel morphology, *Dunes, *Ripple marks, Bed load, Sediment transport, Hydraulics, Steady flow, Turbulent flow, Scour, Regime.
Identifiers: Alluvial channel stability.

The occurrence of different bed forms has been considered as an instability in the flat bed flow. A general functional relationship was developed for the instability of flat bed when it is replaced by either dunes or ripples. Two distinct relationships exist for the two instabilities. A region of transition exists in between the two functions where either instability may occur. The stability function is useful to predict the occurrence of different bed forms. (Knapp-USGS)
W70-00217

FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Giampaolo Di Silvio.
ASCE Proc, J Hydraul Div, Vol 95, No HY5, Pap 6777, p 1589-1614, Sept 1969. 26 p, 9 fig, 2 tab, 25 ref, 3 append.

Descriptors: *Floods, *Waves (Water), *Flood routing, Hydrographs, Flood forecasting, Mathematical models, Open channels, Open channel flow, Unsteady flow, Hydraulics.
Identifiers: Flood wave attenuation.

The general behavior of a flood wave propagating along a prismatic channel is examined. Attenuation is not always to be expected, and a criterion for discriminating attenuation and amplification of flood waves is stated, quite similar to the analogous criterion for infinitesimal perturbations. An approximate procedure for flood waves that are approximately fitted by a triangular shape is developed; a set of nondimensional graphs may be used to predict the modification with respect to time of a triangular wave in dependence of two parameters called 'attenuation' and 'distortion-coefficient.' A simple formula is suggested to calculate peak attenuation or amplification, which does not depend on the distortion coefficient. Comparisons with experimental tests seem to be quite satisfactory. Some auxiliary elements are given for facilitating computations in part-full circular pipes. (Knapp-USGS)
W70-00218

ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
Tippetts-Abbett-McCarthy-Stratton, New York.
For primary bibliographic entry see Field 02E.
W70-00226

DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
California Univ., Irvine. Dept. of Civil Engineering.
Richard R. Brock.
ASCE Proc, J Hydraul Div, Vol 95, No HY4, Pap 6704, p 1401-1427, July 1969. 27 p, 16 fig, 5 tab, 12 ref, 3 append.

Descriptors: *Open channel flow, *Unsteady flow, *Waves (Water), *Hydraulics, *Supercritical flow, Turbulent flow, Model studies, Hydraulic models, Open channels.
Identifiers: Roll waves.

The maximum depth at wave crest, minimum depth at wave trough, wave period and wave velocity of spontaneously developed roll-wave trains were measured in a laboratory channel. Channel slope was varied from 0.05 to 12, normal depth was varied by a factor of 2, and the Froude number of the undisturbed flow (F) ranged from 3.5 to 5.6. For each of the 4 properties, a single development curve resulted for all depths with slope and F fixed. The spatial rate of growth of the average maximum depth increased as F was increased by increasing slope. The growth rate decreased as slope was increased and F was held fixed. Substantial growth occurs when one wave overtakes and combines with another wave. Growth also occurs without wave overtaking. Spontaneously developed roll waves are shown to be related to periodic permanent roll waves. Methods of applying the laboratory results to other channels with inlet conditions similar to that of the laboratory channel are presented. (Knapp-USGS)
W70-00227

FLOW RETARDANCE IN VEGETATED CHANNELS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
Nicholas Kouwen, T. E. Unny, and Harry M. Hill.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR2, Pap 6633, p 329-342, June 1969. 14 p, 7 fig, 2 tab, 21 ref, append.

Descriptors: *Open channel flow, *Vegetation effects, *Roughness (Hydraulic), *Retardance, Streamflow, Model studies, Hydraulic models, Laboratory tests, Flow resistance, Fluid friction, Mannings equation, Roughness coefficient.
Identifiers: Flow retardance.

A quasi-theoretical analysis is given for the flow retardance in vegetated channels. Based on this, a logarithmic flow formula is derived for flow in these channels. The analysis is illustrated with flow data obtained from channels in which natural vegetation was present and from a laboratory flume having flexible artificial roughness elements fixed to the bottom. (Knapp-USGS)
W70-00228

SPREAD OF BUOYANT JETS AT THE FREE SURFACE,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil ENGINEERING.
James J. Sharp.
ASCE Proc, J Hydraul Div, Vol 95, No HY3, Pap 6538, p 811-825, May 1969. 15 p, 4 fig, 1 tab, 20 ref, append.

Descriptors: *Dispersion, *Jets, Open channel flow, Mixing, Model studies, Hydraulic models, Nozzles, Orifices, Stratified flow, Hydraulics, Waste dilution.
Identifiers: Jet spreading, Bouyant jets.

A study is made of the surface spread which occurs when a jet of fluid is discharged at depth into a fluid of greater density. The method of synthesis is used to relate the rate of spread to the conditions at the point where the jet plus entrained fluid flow reaches the free surface. It is explained how these conditions can be related to the initial conditions at the nozzle by means of dilution diagrams. Experiments are described, which confirm the correlation obtained and also provide the basis of a working diagram for rate of spread. The shape of the curves of this spread diagram are explained and it is shown how the curves can safely be extrapolated, in one direction, into the working prototype range. The spread diagram can be used as a means of predicting spread and as a design diagram for choosing scales for hydraulic models. The method for choosing scales is outlined by an illustrative example and the difficulties of incorporating a nozzle in the model to reproduce a prototype spread are emphasized. (Knapp-USGS)
W70-00232

RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
Central Electricity Generating Board, London (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 05D.
W70-00316

PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW,
Toronto Univ. (Ontario).
Bruce D. Prette, and W. Douglas Baines.
Journal of the Hydraulics Division, ASCE, Vol 93, No HY6, Proc Paper SS56, p 53-64, Nov, 1967. 9 fig, 5 ref.

Descriptors: *Turbulence, *Jets, Turbulent flow, Models, Flow.

The shape of a jet issuing normal to a uniform cross wind has been studied experimentally for a large range of jet to wind velocity ratio, R, and over a large distance downstream of the source. A situation with only dynamic effects and a jet to wind velocity ratio more than one (R> 1) is studied. Photographs taken of an oil aerosol jet were used to determine the size and position of the jet; and mean velocity measurements were made close to the outlet. Dimensional analysis shows that for negligible viscous stresses the jet profile and cross section size are functions only of R. A momentum flux equation combined with experimental observation leads to a single form for the profile, with all linear dimensions divided by R. Experimental measurements also show that the shape follows the same parameter, and indicate zones of the jet in which the translational and vortex motions dominate. Consequences of the form of the results are discussed. (Guerrero-Vanderbilt)
W70-00318

HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
New South Wales Univ., Kensington (Australia).
I. R. Wood.
Journal of the Hydraulic Division, ASCE, Vol 93, No HY2, Proc Paper 5139, p 35-42, Mar, 1967. 5 fig, 2 ref.

Descriptors: *Density currents, *Flow, Hydraulic jump, Froude number.
Identifiers: *Entrainment.

The flow in the region of entrainment for a two dimensional horizontal density current was examined and was compared with that of the hydraulic jump. It has been shown that the depth of flow in the region where entrainment has dropped to negligible proportions is uniform and is dependent on the inflowing densimetric Froude number. The data are presented giving the upstream and downstream depths of flow and the shape of the region of entrainment as a function of the inlet densimetric Froude number. Conclusions were: (1) The similarity of entraining and free surface hydraulic jump; (2) The marked effect of the inflowing Froude number on the constant c, which relates inlet Froude number to downstream depth of the density current. (Guerrero-Vanderbilt)
W70-00319

8C. Hydraulic Machinery

SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
Sydney Univ. (Australia).
H. K. Messerle, and D. K. Sweeting.
Inst Eng, Aust, Elec Eng Trans, Vol EE4, No 2, p 179-188, Sept 1968. 10 p, 15 fig, 17 ref.

Descriptors: *Circuit breakers, *Test facilities, *Test procedures, Initial costs, Operating costs, Flexibility, Reliability, Costs, Electric currents, Electric potential, Electrical equipment, Foreign research, Capacitors, Bibliographies.
Identifiers: *Synthetic test methods, Testing equipment, Test results, Foreign testing, Australia, Cost savings, Waveforms.

For reasons of economy and flexibility, synthetic testing of circuit breakers having large breaking capacity is being introduced in place of conventional full-power testing methods. Principal features of synthetic testing of circuit breakers are discussed. Simple and inexpensive capacitive energy storage banks used to set up a synthetic test station for general purpose testing are described. Advantages of a synthetic testing station using capacitive power supplies for the current and voltage sources are given. Using capacitors not only simplifies operation of the test station and reduces operating costs, but also reduces initial cost compared to that for a more conventional test facility. This method simulates field conditions more closely and provides more flexibility than some other testing methods. (USBR)
W70-00326

SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES: II. METHODS OF CONTROL,
Bonneville Power Administration, Portland, Oreg; and General Electric Co, Schenectady, N.Y.
Narain G. Hingorani, and Philip Chadwick.
Direct Curr, Vol 1, No 1, p 25-35, Apr 1969. 11 p, 16 fig, 10 ref.

Descriptors: *Converters (Electrical), Direct current, Alternating current, Electrical design, Control, Foreign research, Electric potential, *Control systems, Electrical equipment, *Electric currents, Rectifiers, Inverters.
Identifiers: Great Britain, Harmonics, *Electric converter valves, Thyristors.

A fully-controlled, single-phase bridge circuit and a corresponding 3-phase version consisting of 3 single-phase bridge circuits in series are evaluated. Using the new control for the single-phase circuit, one valve pair connected to one of the d-c poles may be fired at a different angle of delay than the other valve pair. Angle of delay of one pair is changed until the limit is reached when the angle of delay of the other pair is changed for further control. This mode of operation provides substantial advantage over the converter with conventional control. Part I of the paper describes the operation of the single-phase bridge and the 3-phase series circuit using the new control and discusses various operational features. Part II presents a practical control scheme to obtain the desired control. (USBR)
W70-00346

LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
Royal Inst. of Tech., Stockholm (Sweden).
Sune Rusck.
Direct Curr, Vol 1, No 1, p 41-44, Apr 1969. 4 p, 2 tab.

Descriptors: *Direct current, *Electric cables, *Lightning, *Surges, Electric insulation, Transmission lines, Attenuation, Damping, Time, Calculations, Reflection, Foreign research.
Identifiers: *Lightning surges, Overvoltage, Flashover, Traveling waves, Protection (Electrical), Spark gaps, Sweden.

Lightning surges to which an hvdc cable may be subjected when connected to overhead lines were investigated. Factors determining the magnitude of the voltage are the insulation level of the overhead line, the service voltage, the length of the line-end protection, the time to half-value of the lightning current and the cable attenuation; the magnitude of the lightning current has less influence. The largest surges are obtained on cables having a length less than 90 km at the end of the cable lying farthest away from the point of impact of the lightning stroke, and increase with decreasing cable length. If the cable is more than 30 km long and the basic insulation level of the overhead line is less than 4 times the service voltage, a line-end protection of a few km limits the surge to less than twice the service voltage. A sample calculation shows the effect of various parameters on the magnitude of surges. (USBR)
W70-00349

A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
Kansai Electric Power Co. Ltd., Osaka (Japan); AND Sumitomo Electric Industries Ltd., Osaka (Japan).
Yoshio Shichiri, Matsujiro Yamasaki, and Kazuhiko Okada.
Sumitomo Elec Tech Rev, No 12, p 10-16, Mar 1969. 7 p, 11 fig, 3 tab, 8 ref, append.

Descriptors: *Transmission lines, *Bundled conductors, Wind tunnels, Wind velocity, Test facilities, Test procedures, Drag, Lift, Winds, Vibrations, Foreign research, Wind pressure, Oscillation, *Conductors, *Electric cables.
Identifiers: *Galloping conductors, Test results, Japan, Testing equipment, *Aerodynamic forces.

The dancing (galloping) phenomenon of overhead line conductors caused by low-frequency, large-amplitude oscillations may result in electrical faults and mechanical damage to conductors. The occurrence is usually associated with the formation of ice on conductors, and is apt to increase with the increasing adoption of bundled conductors for overhead transmission lines. Wind tunnel tests were conducted on such aspects as: (1) comparison in aerodynamic force (drag and lift) characteristics between single and bundled conductors; and (2) effect of the twisting movement of bundled conductors on drag and lift force characteristics, particularly emphasizing an analysis of lift force characteristics, data for which have been scarce but closely connected with abnormal oscillation. Results of the wind tunnel tests on twin bundled conductors are described. (USBR)
W70-00359

SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
K. E. Robinson, and H. Taylor.
Can Geotech J Vol 6, No 2, p 119-137, May 1969. 19 p, 8 fig, 3 tab, 1 ref, disc.

Descriptors: *Anchors, *Anchored towers, Foreign construction, Foreign design practices, Transmission lines, *Transmission towers, Field tests, Backfill, *Guyed towers, Cast-in-place structures, Grouting, Economics, Soil investigations, Cost comparisons, Foundations.
Identifiers: Anchor plates, Anchor cables, Grillage rootings, Pull-out tests.

Designing anchors for guyed transmission line towers crossing difficult terrain involves construction considerations and theoretical soil mechanics. Two lines each over 540 mi long were built in British Columbia. Five anchors that were tested are: (1) buried plate with compacted backfill, (2) buried steel mat or grillage with loose backfill, (3) cast-in-place concrete with loose backfill, (4) power installed helical, and (5) grouted rod. The highly variable soil and access conditions along the line necessitated an anchor that could be installed economically in nearly all soil types and by ordinary construction equipment that could easily move between tower sites in rugged terrain. The simply installed, conservatively designed, cast-in-place concrete anchor satisfied these requirements at reasonable cost. Power-installed helical anchors and grouted rod anchors may provide an economical anchor in more uniform soil conditions where easier access exists, but require more detailed soil exploration and contract inspection than the cast-in-place concrete anchors. (USBR)
W70-00361

TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
Ebasco Services, Inc., New York.
A. W. Peabody.
Mater Prot. Vol 8, No 7, p 37-42, July, 1969. 6 p, 13 fig, 7 ref.

Descriptors: *Extra high voltage, *Direct current, Test procedures, *Corrosion, Transmission (Electrical), Corrosion control, Transmission lines, Instrumentation, Electric currents, Pipelines, Underground structure, Protective coatings, Electrical groundings, Electric potential.
Identifiers: *Stray current corrosion, *Ground currents, *Corrosion tests, *Ground return, Earth resistivity (Elect), Potential gradients.

High-voltage, Direct-current (hvdc) transmission systems are expected to be operational in the United States by early 1970. The unique stray current corrosion control problems associated with hvdc transmission involve testing techniques and instrumentation different from those in other types

of corrosion control testing. The importance of corrosion testing with respect to hvdc systems as well as procedures for determining potential gradient patterns and the location of maximum current discharge are discussed. Procedures used to measure current flow on structures are structure-to-earth potentials are described; measurement problems and instrumentation required are outlined. As hvdc systems become operational and experience is accumulated, a cooperative effort will be required to evaluate stray current effects on underground metallic structures and to develop measures of controlling the corrosive action of stray currents. (USBR)
W70-00365

8D. Soil Mechanics

THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
For primary bibliographic entry see Field 07B.
W70-00337

EARTHWORK QUANTITIES BY RANDOM SAMPLING,
Construction Estimating, Inc.; and Gates-Scarpa and Associates, Inc., West Hartford, Conn.
Marvin Gates, and Amerigo Scarpa.
Proc Amer Soc Civ Eng, J Constr Div, Vol 95, No CO1, p 65-83, July 1969. 19 p, 4 fig, 4 tab, 1 ref, 2 append.

Descriptors: *Earthworks, Statistics, Construction, Estimating, Fills, Statistical analysis, *Sampling, Errors, Excavation, Embankments, Cuts, *Computation, *Calculations, *Measurement.
Identifiers: *Random sampling.

Statistical methods are applied to determine earthwork quantities. First, cut and fill areas are delineated and planimetered. Then a table of random numbers is used to locate sample items of depths of earthwork. The volume of earthwork is the product of the planimetered area and the weighted average of the sampled depths. The precision (error) of the answer is expressed as a function of confidence limit, average depth, contour interval, and number of sample items. The method is rapid, accurate, and yields the most meaningful results when compared with any other method used for computing earthwork quantities. The distribution of cut and fill areas can also be determined from the sample items used to find the depth of earthwork, a second source of error. Errors are quantified. (USBR)
W70-00341

FOUNDATION ANCHOR PILES IN CLAY-SHALES,
Prairie Farm Rehabilitation Administration (Saskatchewan).
J. L. Jaspar, and V. W. Shtenko.
Can Geotech J, Vol 6, No 2, p 159-175 May 1969. 17 p, 13 fig, 2 tab, 1 ref.

Descriptors: *Anchors, *Piles (Foundations), Pile spacing, Slabs, Clay shales, *Pile foundations, Shales, Spillways, Foundations, Field tests, *Expansive clays, *Expansive soils, Expansive forces, Swelling, Rebound, Foreign research, Foreign design practices, Differential displacements.
Identifiers: Pile tests, *Bearpaw shale, Swelling pressures, Canada, Belled anchors.

A test program was conducted at Gardiner Dam on the South Saskatchewan River Project, Canada, to obtain data on the design and performance of anchor piles installed in the Bearpaw shale formation. The formation is hard, is relatively undisturbed, contains joints or fissures in some places, has a water content less than 27%, and has a wet density greater than 120 pcf. The test area excavation was approximately 50 ft deep. Four test series were conducted, including quick loading by hydraulic jacks, long-term loading from swelling, and both of these types of loadings on piles with and without bells. The recommended design includes depth of anchoring, pile spacing, and size of anchor rod for various bell sizes. The design provides for some stretching without failure due to load applied through swelling of the shale. This will not eliminate swelling, but will reduce the rate and amount of swelling or differential movement. (USBR)
W70-00360

FOUNDATION FAILURES OF FOUR ROCKFILL SLOPES,
Council for Scientific and Industrial Research, Pretoria (South Africa).
Geoffrey E. Blight.
Proc ASCE, J Soil Mech Found Div, Vol 95, No SM3, p 743-767, May 1969. 25 p, 16 fig, 5 tab, 21 ref, append.

Descriptors: Clays, Fissures (Geology), Laboratory tests, *Rock fills, Overconsolidation, Shear tests, Shear, *Shear failures, Shear planes, *Shear strength, Vane shear tests, Slopes, Slope stability, *Foundation failure, Joints (Geology), Failures, Model tests, Waste dumps, Stability analysis, Soil mechanics, Quartzite, Bibliographies, Foundations.
Identifiers: In situ tests, Failure surfaces.

Failures of rockfill slopes were interpreted as large-scale shear tests on the foundation strata of stiff fissured clay. Analyses of the slope failures, together with in situ and laboratory shear tests on the clay, provided information on the relation between the strength in bulk of a stiff fissured clay and that measured by small-scale tests. Two failures were progressive and 2 were nonprogressive. For the nonprogressive failures and one progressive failure, strength in bulk was approximately equal to strength measured in small-scale field and laboratory tests. Strength in bulk found from the remaining progressive slide was less than strengths measured in small-scale tests. At all 4 sites in situ, effective horizontal stresses in the clay strata were about equal to the passive pressure resistance of the clay. This fact was used to provide an alternative assessment of bulk strength of the clay. (USBR)
W70-00363

8E. Rock Mechanics and Geology

ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 02F.
W70-00248

STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
Technische Hochschule, Karlsruhe (West Germany).
For primary bibliographic entry see Field 02F.
W70-00249

A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
Pierre Patin.
Transl from Fr, Bur Reclam Transl 814, July 1969. 44 p, 17 fig, disc. Ann Inst Tech Batiment Trav Publics, Vol 22, No 253, p 1-20, Jan 1969.

Descriptors: *Reservoir leakage, *Reservoirs, Lakes, Karst, Lightweight aggregates, *Sealants, Permeability, Density, Materials, Fibers, *Settling velocity, *Leakage, Filters, Seals (Stoppers), Suspended solids, Plastics, Seepage, Bituminous materials, *Reservoir surveys, Foreign research, Reservoir operation, Groundwater flow.
Identifiers: Sealing layers, Foreign testing, France, Greece, Asphalt emulsions, Lake Yliki (Greece), Lightweight concretes.

Leaks in reservoirs may be detected by placing a specially constructed long-bristle mop in the water and observing the orientation of the bristles. Another method is to systematically dispense colored bristles into the water and record movement of the fiber by aerial photography or underwater divers. The method for sealing leaks consists of selecting various-sized solid materials having a density approximately equal to water, suspending them in water, and relying on water current flowing through the leak to deposit them. A natural barrier is built up by successively depositing fiber-size materials. The required density of the materials, settling velocity, and preparation of suitable materials for large- and small-size particles are discussed. Materials for large-size particles include pumice and cellular concrete. Density is controlled by coating the particles with asphalt emulsion. A mixture of plastic fibers is used as smaller-sized material. Final sealing is accomplished by depositing rubber emulsion or bituminous filaments. Field studies are described for detecting and sealing leaks at Lake Yliki in Greece. (USBR)
W70-00322

PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
Pierre Londe, and Francis Sabarly.
Comptes-rendus, Premier Congres Soc Int Mec Roches, Lisbonne, Vol 2, p 517-521, 1966. 21 Transl from Fr, Bur Reclam Transl 815, July 1969. 13 p, 7 fig, 1 tab.

Descriptors: *Permeability, *Rock mechanics, *Rocks, Laboratory tests, *Rock foundations, Arch dams, Fissures (Geology), Grouting, Percolation, Drainage, Drains, *Compression, Stress, Watertight, Engineering geology, *Dam foundations.
Identifiers: In situ rock, In situ tests, Rock pressures, Permeability coefficients, Permeability tests, Compression tests, Radial diffusion.

Laboratory tests show that the permeability of small specimens of fissured rock varies with the compressive stress applied. This property can be extended to the scale of rock masses. Simplified computations, borne out by in situ tests, establish that fissures in most rock masses are very narrow, and that their width and the permeability of the mass are very responsive to variations in compressive stress. These findings point to the probability of a watertight barrier being formed in the foundation rock in the direction of the forces exerted by an arch dam, and to the consequences of this factor on the design of the grouting and drainage systems. Reducing the amount of grouting should be possible, which for the most part is not only expensive but useless. Systematizing drainage should be possible also, making it a fundamental and economical element in the stability of foundations. (USBR)
W70-00323

FOUNDATION TESTING FOR AUBURN DAM,
Bureau of Reclamation, Denver, Colo.
George B. Wallace, Edward J. Slebir, and Fred A. Anderson.
Pap, 11th Symp Rock Mech, Univ Calif, Berkeley, June 1969. 86 p, 31 fig, 2 tab, 12 ref.

Descriptors: Arch dams, Concrete dams, *Rock properties, Schists, *Dam foundations, Field investigations, *Foundation rocks, Foundations, *Foundation investigations, Stress relieving, Foundation bearing tests, Rock mechanics, Abutments, Discontinuities, Field tests, Shear tests, Engineering geology.
Identifiers: Rock competency, Auburn Dam (Calif), *In situ tests, Radial jacking tests, Sliding tests, Plate bearing tests, *Rock testing.

Auburn Dam will be a thin, double-curvature concrete arch dam 685 ft high with a crest length of 4000 ft. The foundation rock consists of a steeply inclined sequence of foliated metamorphic rock, chiefly amphibolite with minor talc and chlorite schists and serpentine. Both abutments and the channel section contain faults, shear zones, and joints. Geologic mapping of the various rock types and discontinuities, along with design considerations, is providing a basis for the foundation testing program. The program includes uniaxial and radial jacking tests to obtain load vs time deformation relationships, shear and block sliding tests for cohesion and friction factors, plate bearing test to evaluate compressibility of fault gouge, and stress relief tests to determine stress magnitude and direction in the rock mass. Test methods are described and field testing is discussed. Laboratory tests of NX core are performed concurrently to determine physical and petrographic properties. (USBR)
W70-00324

COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-00332

THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
B. A. Petrushevskiy.
Phys Solid Earth, No 10, p 648-652, Oct 1968. 5 p, 5 ref.

Descriptors: *Earthquakes, Hazards, *Seismology, Geophysics, Economic impact, Seismic investigations, Geologic investigations, Psychological aspects, Population, Social aspects, Social impact, Safety, Urban areas, Warning systems, Foreign research, *Forecasting.
Identifiers: Earthquake focus, *Earthquake forecasting, Earthquake zones, Epicenters, USSR.

The possibility of accurately predicting the time of an earthquake is an unusually attractive prospect. Given advanced warning, persons living in cities could leave for places of safety. Damages would be limited to the destruction of empty buildings; thousands of lives would be saved. Looking at the practical aspects, earthquake prediction is very different from this idyllic situation. Prediction of occurrence-time apparently has priority over the prediction of when, how violently, and how frequently earthquakes may be expected. The scientific validity of earthquake-time prediction is very low and the effects of very unreliable earthquake-time prediction have yet to be considered. The lack of precision could cause serious mental trauma to populations waiting for an earthquake to strike, and the disruption of normal daily life would have far-reaching economic consequences to industry and Government. Earthquake-time prediction should not be neglected, but should be given an appropriate part in a thoroughly thought out and widely based multiple-prediction program. Determination of place and force of an approaching earthquake has developed from a theoretical study to a practical job, and should be given top priority in earthquake prediction for years to come. (USBR)
W70-00333

THE SLIDING STABILITY OF DAMS,
For primary bibliographic entry see Field 08A.
W70-00347

FAILURE OF FRACTURED ROCK,
National Mechanical Engineering Research Inst., Pretoria (South Africa).
Z. T. Bieniawski, H. G. Denkhaus, and U. W. Vogler.
Int J Rock Mech Mining Sci, Vol 6, No 3, p 323-341, May 1969. 23 p, 17 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Rock mechanics, Rock properties, Quartzite, *Compressive strength, *Failure (Mechanics), Fractures, Rock excavation, *Rupturing, Stress, *Stess-strain curves, Strain, Testing machines, Sandstones, Test procedures, *Triaxial compression, Underground structures, Unconfined compression, Fractures (Geology).
Identifiers: Rockbursts, Rock tests, Foreign testing, Underground openings, Confining pressure, South Africa, *Multiaxial tests.

The most effective way of studying failure of fractured rock is by determining the complete stress-strain characteristics of the rock. Experimental techniques and multiaxial compression testing procedures are prescribed for determining the complete stress-strain curves for hard and soft rock. Special equipment was designed for this purpose. Test results are given on soft sandstone, hard quartzite, and hard norite. Modes of failure are reviewed. The strength and deformation characteristics of fractured rock are discussed and the significance of the test results is outlined. (USBR)
W70-00350

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
National Technical Univ., Athens (Greece).
C. E. Tsoutrelis.
Ink, J Rock Mech Mining Sci, Vol 6, No 3, p 311-321 May 1969. 12 p, 6 fig, 3 tab, 12 ref, append.

Descriptors: *Rock mechanics, Rocks, Rock properties, Test procedures, *Drill holes, *Drilling, *Boreholes, Penetration, *Compressive strength, Unconfined compression, Engineering geology, Laboratory tests, Field tests.
Identifiers: *Rock tests, *Diamond drilling, Drillability index, Foreign testing, Greece, In situ tests, In situ rock.

A method has been developed for determining the compressive strength of rock in situ or in test blocks. Two equations are derived from experimental data to relate uniaxial compressive strength to diamond drill penetration rate. The validity of the method has been tested in the laboratory and in situ on several rocks ranging in compressive strength from 500 to 1300 kp/sq cm. Results are in good agreement with the Bureau of Mines standard procedure for compressive strength. The method (1) avoids the difficulties of specimen preparation, (2) is not affected by invisible cracks or discontinuities in the rock, (3) shows that compressive strength determination becomes more representative for the rock mass as drilling distance increases, and (4) is particularly useful for underground operations where a diamond drill is generally available. (USBR)
W70-00357

8F. Concrete

PHILOSOPHY OF FAILURE,
Imperial Coll. of Science and Technology, London (England). Dept. of Engineering.
For primary bibliographic entry see Field 08A.
W70-00294

SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
Swedish Geotechnical Inst., Stockholm.
Bengt B. Broms.
Proc Amer Soc Civ Eng, J Struct Div, Vol 95, No ST6, p 1339-1358, June 1969. 20 p, 12 fig, 1 tab, 19 ref, append.

Descriptors: *Shear strength, *Reinforced concrete, Girders, Rotation, *Beams (Structural), Cracks, Structural engineering, Flexural strength, Reinforcement, Stress distribution, Laboratory tests, Strain, Failure (Mechanics), Stress concentration, Compression, Bibliographies, Shear.
Identifiers: *Diagonal tension, Stirrups, Ultimate strength.

Stress distribution at failure and failure modes of reinforced concrete beams with and without web reinforcement failing by shear-compression have been investigated. Behavior of these members is unaffected by the presence of the web reinforcement until one or several inclined cracks have formed within the shear span. The fact that diagonal tension cracks initiate at or close to existing flexural cracks indicates that the secondary stresses caused by the flexural cracks affect the diagonal tension cracking load. Stress redistribution taking place at the diagonal tension cracking load is caused by internal local rotation, increasing the width of the diagonal tension cracks. The crack width is proportional to the distance from the center of rotation at the apex of the diagonal tension crack. The ultimate strength of beams failing by shear-compression is dependent on the location of the diagonal tension crack within the compression zone, and the shear span ratio. The diagonal tension crack is located at the center of the compression zone. (USBR)
W70-00328

REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
Intrusion-Prepakt Inc., Cleveland, Ohio.
Bruce A. Lamberton.
Proc Amer Soc Civ Eng, J Constr Div, Vol 95, No CO1, p 49-54, July 1969. 6 p, 5 fig.

Descriptors: Construction, Construction materials, Textiles, *Concrete construction, Concrete structures, Columns, Embankments, Nylon, *Erosion control, *Formwork (Construction), *Revetments, Mortar, Bank protection, Slope protection.
Identifiers: Construction methods, *Facings, Fabrics, *Fabriform method, *Concrete linings.

The Fabriform process employs a high-strength, water-permeable, synthetic fabric as a concrete forming material. The water-cement ratio is reduced by forcing vehicle water through the fabric, causing substantial increase in strength and very rapid stiffening. Proper fabric design is essential to avoiding mortar loss. Applied to construction of erosion-control revetments, dual-wall fabric is placed on the surface to be protected and filled with mortar. The 2 layers of fabric may be woven together at regular intervals to form filter points providing relief from hydrostatic uplift. A uniform cross section is also available, containing internal fiber reinforcing. Fabriform is a reliable method for placing revetments of predictable dimensions above and below water, and may be applied to columns and thin-shell structures.
W70-00334

INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
Pennsylvania Dept. of Highways.
P. D. Stewart, and R. K. Shaffer.
Highw Res Rec, No 268, p 1-16, 1969. 16 p, 4 fig, 13 tab, 1 ref.

Descriptors: Concretes, Concrete technology, Concrete testing, Curing, *Curing compounds, *Protective coatings, *Sealants, *Surface sealing, Laboratory tests, Freeze-thaw tests, Penetration, Bituminous materials, Bonding.
Identifiers: Surface treatment, Bond, Bond strength, Bond tests.

Thirty-two products used as concrete protective sealants and curing compounds were evaluated in a 4-phase testing program. In the first phase, the ability of penetrating-type sealants to protect concrete against the deteriorating action of freeze-thaw cycles was evaluated. Concrete specimens measuring 1 ft square were coated with various product applications, filled with a chloride solution (5%), and subjected to 100 cycles of freeze-thaw. Surface scaling was measured at intervals using a numerical value system. During the second phase, 10 products recommended as combination curing-sealing compounds were tested. The curing properties were determined by comparing compression strengths of product-cured and moist room-cured

cylinders. Slab specimens cured with each product were subjected to freeze-thaw tests. In the third phase, a test method was designed to measure depth of sealant penetration into the surface of a typical concrete slab. A fluorescent material was mixed with several products before application; penetration was measured by linear traverse equipment using ultraviolet light. The fourth phase was devoted to equipment design and methods for determining the effect of sealants on bond between concrete and bituminous overlays. (USBR)
W70-00338

THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
Hydro-Electric Power Commission of Ontario, Toronto.
V. R. Sturrup, and T. G. Clendenning.
Highw Res Rec, No 268, p 48-61, 1969. 14 p, 18 fig, 3 ref.

Descriptors: Concretes, *Concrete technology, *Concrete testing, Fly ash, Freeze-thaw tests, *Field tests, Laboratory tests, Durability, Air entrainment, *Concrete additives, Aggregates, Scaling, Cracking, Water-cement ratio.
Identifiers: Deleterious materials, Entrainment, Concrete properties.

Studies on outdoor performance of concrete have included variations in the water-cement ratio, the paste composition, and the aggregate quality. Parallel tests were performed in laboratory freeze-thaw apparatus by the rapid water-freeze cycle. Results indicate that when only one variable is changed, the accelerated freeze-thaw and the outdoor exposure tests place similar concretes in the same relative order of durability. A difference was noted in the breakdown in outdoor exposure between that caused by nondurable paste and that caused by nondurable aggregates. Progressive scaling below the waterline is associated with breakdown in the paste, while progressive popping and cracking is associated with unsound aggregates. Entrained air will not protect a nondurable coarse aggregate but under certain conditions may delay deterioration. While the benefits of entrained air are evident in both tests, accelerated freeze-thaw overemphasizes its performance compared with nonair-entrained concrete. On the outdoor exposure tests, benefits of entrained air are most pronounced at high water-cement ratios. (USBR)
W70-00340

MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
Pennsylvania State Univ., University Park.
P. D. Cady.
J Mater, Vol 4, No 2, p 294-311, June, 1969. 18 p, 6 fig, 6 tab, 7 ref.

Descriptors: *Aggregates, *Concrete technology, Adsorption, Concretes, Differential thermal analysis, *Frost action, Durability, Freeze-thaw, Tests, Test procedures, Instrumentation, Concrete testing, Expansion, Coarse aggregates, Petrographic investigations.
Identifiers: *Adsorbed water theory, Dilation, Concrete properties, Hydraulic pressure theory, Volume change.

The hydraulic pressure theory proposed by Powers and the adsorbed water theory recently advanced by Dunn and Hudec to describe the destructive mechanisms of frost action on concrete aggregates were investigated. The theories were in direct opposition regarding the state of water during the period when coarse aggregate underwent destructive volume change. Nine aggregate fractions of known and widely varying durability were tested for adsorption. Differential thermal analyses were performed on concrete specimens containing test fractions to determine the degree of freezability of the evaporable water content. Expansion (dilations) of test specimens were also obtained during the DTA runs. Multiple correlation analyses of test variables and examination of changes in heat evolution and specimen length during cooling revealed that Powers' hydraulic pressure mechanism was the major contributor to destructive volume change. However, the existence of the mechanism proposed by Dunn and Hudec was consistently in evidence. The latter mechanism was a minor contributor to the destructive volume change, but was the major effect for one of the test aggregates. At least 2 basic mechanisms were involved in frost destruction of concrete aggregates. (USBR)
W70-00362

8G. Materials

QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
Princeton Univ., N.J. Dept. of Chemical Engineering.
Donald D. Joye, and Robert C. Axtman.
Anal Chem, Vol 40, No 6, p 876-878, May 1968. 3 p, 1 fig, 1 tab, 8 ref.

Descriptors: *Corrosion, *Chemical analysis, Chemical reactions, Rusting, Water chemistry, Well casings, Radiochemical analysis.
Identifiers: Mossbauer Effect.

The development of quantitative methods that utilize the Mossbauer Effect has lagged because of experimental difficulties. The corrosion of thin samples of iron, however, is a nearly ideal system for nondestructive, quantitative assay by a Mossbauer method. A constant acceleration spectrometer gave the ratio of the amount of unreacted iron to that of corrosion product formed in an atmosphere of water, Hydrochloric acid, and air. The spectrometer furnished an internal calibration for the method while a simple gravimetric technique provided an absolute calibration. Qualitative interpretation of the Mossbauer spectra aided in identification of the corrosion product. At room temperature the ratio of the Mossbauer efficiency of iron to that of the corrosion product is 1.61. (Knapp-USGS)
W70-00046

OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
Carborundum Co., Niagara Falls, N.Y.
Charles A. Bicking.
Mater Res Stand, Vol 9, No 6, p 8-13, 76, June 1969. 7 p, 8 fig, 5 ref.

Descriptors: Materials, Information retrieval, *Materials control, Materials engineering, *Materials testing, *Mathematical models, Digital computers, Mathematics, *Operations research, Experimental data, Quality control, Simulation, Specifications, Automatic control, Decision making, Instrumentation, Measuring instruments, PERT.
Identifiers: Materials information, Experimental design, Analog-to-digital converter.

Opportunities for direct coupling of materials science and operations research are described. In research and development, attention is directed to materials characterization, design, and analysis of experiments, and the selection and control of projects. In materials manufacture, areas of mutual activity include: (1) measurement and control of materials; (2) specification and acceptance or certification, including the design implications of materials; and (3) allocation of materials. Also discussed is the impact of computers in an age when requirements placed on materials are severe. In the future, simulation of applications will be the primary avenue of development new materials. (USBR)
W70-00325

LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
Bureau of Reclamation, Denver, Colo.
W. R. Morrison.
Bur Reclam Lab Rep (ChE-91), Chem Eng Br, June, 1969. 40 p, 6 fig, 15 tab, 7 photo, 8 ref.

Descriptors: Laboratory tests, Asphalt, *Asphalt cement, Penetration, *Bituminous materials, Buried membranes, *Canal linings, Ductility, Data processing, Field tests, *Impervious linings, Materials testing, *Aging (Physical), Impervious membranes, Laboratory equipment, Weathering, Computer programming, Computers, Hardening.
Identifiers: Catalytically blown asphalt, Softening point, Product evaluation.

Laboratory test results indicate that the 14-day, 140 deg F oven aging test and the thin film oven test (ASTM D-1754) are satisfactory for determining the aging characteristics of asphalt cements used in membrane lining construction. Hardening is indicated by a decrease in penetration and ductility and an increase in softening point. These changes were reflected in the aging indexes. The 14-day aging test produced greater asphalt hardening. An aging index of 63.4 was obtained for asphalt cements subjected to the 14-day aging test, compared to an aging index of 73.7 for samples of the same asphalt cements subjected to the thin film oven test. New asphalt cements, by definition, have an aging index of 100. Comparing laboratory aging with field aging indicated that the 14-day, 140 deg F oven aging test produced asphalt hardening similar to that obtained at 14 yr field exposure. The thin film oven test produced asphalt hardening equivalent to 7 yr field aging. Based upon this investigation and other studies, asphalt cements now specified for Bureau of Reclamation membrane construction will provide satisfactory service for at least 14 yr. (USBR)
W70-00330

REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
Intrusion-Prepakt Inc., Cleveland, Ohio.
For primary bibliographic entry see Field 08F.
W70-00334

COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
City Univ., London (England).
For primary bibliographic entry see Field 08A.
W70-00339

SYSTEMS APPROACH TO ORGANIC COATINGS,
Du Pont de Nemours (E.I.) and Co., Philadelphia, Pa.; and PPG Industries, Inc., Springdale, Pa.
T. R. Matthews, M. M. Coburn, and L. R. LeBras.
Metal Progr, Vol 95, No 6, p 67-74, June, 1969. 8 p, 3 fig, 3 tab.

Descriptors: *Painting, *Paints, Primers (Painting), Curing, Finishes, Organic compounds, *Protective coatings, Varnishes, Lacquers, *Coatings, Films, Application methods, Enamels, Durability, Materials engineering, Costs.
Identifiers: Product evaluation, Plastic coatings.

Factors involved in selecting and applying an effective and economical coating system are discussed in a series of 3 articles. Organic coatings differ from conventional paints and from each other in composition, application method, curing, and performance characteristics. Many product finishes are special systems formulated for a single user, but are of general availability. Selection of the correct coating is discussed and relative durability, advantages, and limitations are summarized. Several application methods are reviewed. Solvent evaporation, oxidation, and polymerization methods for curing organic coatings are reviewed, as well as a short summary on electron-beam curing. The selected coating must be compatible with the application and curing methods, and capable of achieving the desired performance. Primers and topcoats must form a strong adhesive bond and are preferred for procurement from the same manufacturer. A systems approach is required for evaluat-

ing and selecting an organic coating for a given application. (USBR)
W70-00358

8I. Fisheries Engineering

FISH LADDERS - REGULATIONS.
For primary bibliographic entry see Field 06E.
W70-00118

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
For primary bibliographic entry see Field 04A.
W70-00195

FISH AND WILDLIFE RESOURCES.
For primary bibliographic entry see Field 03E.
W70-00199

FISH AND GAME (FISHING REGULATIONS).
For primary bibliographic entry see Field 06E.
W70-00212

SPORT FISHING.
For primary bibliographic entry see Field 06E.
W70-00409

SPORT FISHING.
For primary bibliographic entry see Field 06E.
W70-00410

SPORT FISHING.
For primary bibliographic entry see Field 06E.
W70-00411

SPORT FISHING.
For primary bibliographic entry see Field 06E.
W70-00412

10. SCIENTIFIC AND TECHNICAL INFORMATION

A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
Marshall Gysi, and Daniel P. Loucks.
New York Water Resources and Marine Sciences Center, Publication No 25, Aug, 1969. 177 p, 500 ref, 8 index charts. OWRR Proj W-111. Available from the Clearinghouse as PB 186 335, $3.00 in paper copy, and $0.65 in microfiche.

Descriptors: *Bibliographies, *System analysis, *Water resources, Optimization, Simulation analysis, Operations research, Abstracts.

Presented is an annotated bibliography of some selected publications pertaining to the application of systems analysis techniques to water-resource problems. The majority of the references included in this bibliography have been published within the last five years, mainly in Selected Water Resources Abstracts. About half of the entries have informative abstracts and keywords following the citation. Index charts give quick keyword access for all the references, the abstracted documents being completely keyworded, and the others title keyworded. The emphasis of the subject material abstracted is on optimization and simulation techniques that have been applied to water-resource problems.
W70-00306

STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
Federal Water Pollution Control Administration, West Kingston, R.I.
For primary bibliographic entry see Field 05C.
W70-00417

SUBJECT INDEX

ACCESS ROUTES
ACCRETION - A NEW SLANT,
W70-00170 04A

ACCRETION (LEGAL ASPECTS)
MCCUE V CARLTON (TITLE TO ACCRETIONS).
W70-00061 06E

ACCRETION(LEGAL ASPECTS)
BANKS V CHICAGO MILL AND LUMBER CO (ACCRETIONS TO RIPARIAN LAND).
W70-00165 06E

ACCRETION - A NEW SLANT,
W70-00170 04A

ACID BACTERIA
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

ACID MINE WATER
CONTROL OF MINE DRAINAGE WATER,
W70-00069 05G

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
W70-00167 05G

EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

ACTIVATED SLUDGE
ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A PILOT STUDY OF TREATING COMBINED CHROME TANNERY WASTES AND DOMESTIC SEWAGE.
W70-00163 05D

ADJUDICATION PROCEDURE
ORGANIZATION OF DRAINAGE DISTRICTS.
W70-00408 04A

ADMINISTRATION
OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.
W70-00087 04D

ADMINISTRATIVE ASPECTS (OF WATER), (IN DUTCH),
W70-00297 06D

PLANS OF RECLAMATION.
W70-00396 04A

ADMINISTRATION AGENCIES
INTERSTATE BRIDGES.
W70-00373 04A

ADMINISTRATIVE AGENCIES
STATE PLANNING.
W70-00098 06E

HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
W70-00102 06E

STATE PLANNING MISCELLANEOUS PROJECTS.
W70-00105 06E

FISH AND WILDLIFE RESOURCES.
W70-00106 06E

INDIANA STATE TOLL BRIDGE COMMISSION.
W70-00111 06E

WATER WELL DRILLERS.
W70-00179 04B

A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
W70-00184 06D

RIVERS STREAMS AND WATERWAYS.
W70-00186 05G

OHIO RIVER AREA COORDINATING COMMISSION.
W70-00196 06B

LEVEE AUTHORITY DISTRICTS.
W70-00197 04A

PUBLIC PARKS-WATERS-POWERS OF THE BOARD.
W70-00366 06E

WATERSHED CONSERVANCY DISTRICTS.
W70-00368 04D

INTERSTATE BRIDGES.
W70-00374 04A

W70-00375 04A

W70-00376 04A

W70-00377 04A

STREAMS AND WATERS.
W70-00381 05G

SENECA PORT DISTRICT.
W70-00393 04A

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
W70-00395 04A

SANITATION DISTRICTS.
W70-00399 05G

W70-00400 05G

W70-00401 05G

W70-00402 05G

SOIL AND WATER CONSERVATION COMMISSION.
W70-00404 04A

ARKANSAS FORESTRY COMMISSION.
W70-00407 04D

ADMINISTRATIVE DECISIONS
SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).
W70-00103 06E

OPEN SEASON AND BAG LIMITS.
W70-00120 06E

ADSORBED WATER THEORY
MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

ADSORPTION
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

ADVECTION
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

AERIAL PHOTOGRAPHY
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

AERODYNAMIC FORCES
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

AGGREGATES
MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

AGING(PHYSICAL)
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

ALASKA
GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

ALGAE
SEA PLANTS FOR FOOD,
W70-00161 03C

DEATH OF A LAKE,
W70-00264 05C

ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

ALLUVIAL CHANNELS
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

ALLUVIUM
GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

AMMONIA
AMMONIA NITROGEN LOSSES FROM STREAMS,
W70-00267 05G

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

AMMONIA-NITROGEN
AMMONIA NITROGEN LOSSES FROM STREAMS,
W70-00267 05G

ANABAENA FLOS-AQUAE
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

ANALOG MODELS
ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

ANALYTICAL TECHNIQUES
SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

ANCHORED TOWERS
SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

ANCHORS
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

ANTARCTIC
ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

ANTIMETABOLITES
PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

ANTI-POLLUTION LEGISLATION
STRIP MINING.
W70-00177 05G

APHANIZOMENON FLOS AQUAE
CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

APPORTIONMENT OF DAMAGES
SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
W70-00389 04A

AQUATIC LIFE
BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
W70-00303 05C

AQUATIC PLANTS
THE CONTROL OF WATER WEEDS.
W70-00269 05G

AQUATIC WEED CONTROL
THE CONTROL OF WATER WEEDS.
W70-00269 05G

AQUATIC WEEDS
THE CONTROL OF WATER WEEDS.
W70-00269 05G

AQUEOUS SOLUTIONS
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

AQUIFERS
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

ARCH DAMS
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND MORROW POINT DAMS,
W70-00335 08A

ARKANSAS
RIPARIAN RIGHTS - REASONABLE USE THEORY.
W70-00083 04A

OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.
W70-00087 04D

STATE PLANNING.
W70-00098 06E

MISSISSIPPI RIVER PARKWAY.
W70-00100 06E

BANKS V CHICAGO MILL AND LUMBER CO (ACCRETIONS TO RIPARIAN LAND).
W70-00165 06E

TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

FISH AND GAME (FISHING REGULATIONS).
W70-00212 06E

FISH AND GAME (MUSSELS)
W70-00236 06E

MILLS AND MILL DAMS.
W70-00245 04A

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).
W70-00379 06G

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
W70-00398 04A

SOIL AND WATER CONSERVATION COMMISSION.
W70-00404 04A

ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
W70-00406 04A

ARKANSAS FORESTRY COMMISSION.
W70-00407 04D

ASPEN TREES
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

ASPHALT CEMENT
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

ATLANTIC OCEAN
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

ATLANTIC SALMON
SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).
W70-00188 03E

AUSTRIA
SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

AXEL HEIBERG ISLAND
WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

BACTERIA GROWTH
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

BAFFIN ISLAND
EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

BAG LIMITS
OPEN SEASON AND BAG LIMITS.
W70-00120 06E

BASE FLOW
NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

BATTURE LAND
HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).
W70-00372 06E

BAYS
INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

BEACH EROSION
A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
W70-00043 02J

BEAMS(STRUCTURAL)
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
W70-00328 08F

COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

BEARPAW SHALE
FOUNDATION ANCHOR PILES IN CLAY-SHALES,

W70-00360 08D

BED MOVEMENT
EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

BEDS UNDER WATER
PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
W70-00112 03E

BEIJERINCKIA
NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

BELGIUM
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

BENEFITS
CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
W70-00313 06B

BENTHOS
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

BIBLIOGRAPHIES
REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
W70-00306 10

BIOCHEMICAL OXYGEN DEMAND
MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

BIOGEOCHEMISTRY
THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

BIOMASS
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

BITUMINOUS MATERIALS
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

BLACK SEA
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

BLACK SEA SEDIMENTS
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

BLOOD CELL MORPHOLOGY
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

BOATING REGULATIONS
REGISTRATION OF MOTORBOATS.
W70-00115 06E

BOATS
REGISTRATION OF MOTORBOATS.
W70-00115 06E

FERRIES ON STREAMS WITHIN STATE.
W70-00352 06E

BOD MASS BALANCE
PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

BOREHOLES
THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

BOUNDARIES(PROPERTY)
MCCUE V CARLTON (TITLE TO ACCRETIONS).
W70-00061 06E

TOWNSHIPS AND COUNTY LINE BRIDGES.
W70-00109 06E

BANKS V CHICAGO MILL AND LUMBER CO (ACCRETIONS TO RIPARIAN LAND).
W70-00165 06E

COUNTY LINE BRIDGES.
W70-00336 04A

TOWNSHIP LINE BRIDGES.
W70-00354 04A

BRAHMAPUTRA RIVER(INDIA-PAKISTAN)
INVESTIGATION OF BRAHMAPUTRA RIVER,
W70-00219 02E

BRAZIL
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

BRICK MASONRY
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

BRICKS
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

BRIDGE CONSTRUCTION
TOWNSHIPS AND COUNTY LINE BRIDGES.
W70-00109 06E

COUNTY LINE BRIDGES.
W70-00336 04A

INTERSTATE BRIDGES.
W70-00373 04A

W70-00374 04A

W70-00375 04A

W70-00376 04A

W70-00377 04A

BRIDGE CONSTUCTION
TOWNSHIP LINE BRIDGES.
W70-00354 04A

BRIDGES
HIGHWAYS, BRIDGES, AND FERRIES-PROVISIONS FOR PARTICULAR COUNTIES.
W70-00094 06E

COUNTY BRIDGE CONSTRUCTION.
W70-00108 06E

INDIANA STATE TOLL BRIDGE COMMISSION.
W70-00111 06E

BRIDGES, CULVERTS, SEWERS AND WATERCOURSES IN SECOND CLASS CITIES.
W70-00301 06E

BRIDGES OVER CANALS.
W70-00355 04A

BUNDLED CONDUCTORS
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

BURIAL GROUNDS
POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.
W70-00384 06E

CALCULATIONS
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

CALIFORNIA
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
W70-00067 02L

THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

CALIFORNIA AQUEDUCT
STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

CALIFORNIA SOLUTES
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

CANADA
OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00009 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

CANAL LININGS
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

CANALS
CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

BRIDGES OVER CANALS.
W70-00355 04A

CARQUINEZ STRAIT(CALIF)
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

CEGB STATIONS
CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

CEMETARIES
POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.
W70-00384 06E

CHANNEL FLOW
THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

CHANNEL IMPROVEMENT
WATERCOURSES - CANALS - TOLL BRIDGES.
W70-00122 06E

CHICAGO SANITARY DISTRICT.
W70-00174 05G

W70-00175 05G

PORT AUTHORITIES.
W70-00194 04A

CHANNEL MORPHOLOGY
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

CHEMICAL ANALYSIS
QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
W70-00046 08G

SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

CHEMICAL OCEANOGRAPHY
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

CHEMICAL PROPERTIES
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

CHESAPEAKE BAY
SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

CHICAGO DEEP TUNNEL PLAN
GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

CHICAGO(ILL)
LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
W70-00263 05B

CHLORELLA
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

CHLORELLA ELLIPSOIDEA
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

CHROMIUM
SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

CIRCUIT BREAKERS
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

CITIES
MUNICIPAL WATER SUPPLIES,
W70-00074 06E

CONDEMNATION BY COUNTY OR CITY FOR FLOOD CONTROL.
W70-00101 06E

FLOOD CONTROL SYSTEMS.
W70-00200 04A

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

JOINT OPERATION OF WATER SOURCES.
W70-00276 03D

BRIDGES, CULVERTS, SEWERS AND WATERCOURSES IN SECOND CLASS CITIES.
W70-00301 06E

POWER TO ACQUIRE CONTROL AND DISPOSE OF PROPERTY.
W70-00364 06E

DRAINAGE DISTRICTS EMBRACING PART OR WHOLE OF CITY OR TOWN.
W70-00390 04A

CLASSIFICATION
WATER POLLUTION CONTROL.
W70-00168 05G

CLEANING
WATERCOURSES - CANALS - TOLL BRIDGES.
W70-00122 06E

CLIMATOLOGICAL DATA
WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1968.
W70-00138 07C

CLIMATOLOGY
VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

CLOUD SEEDING
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

COASTAL ENGINEERING
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

COCONUT WATER
PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

COLIFORMS
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

COLLUVIUM
MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

COLOR
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

COMMERCE
NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

COMMERCIAL DEVELOPMENT
INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
W70-00114 06E

COMMERCIAL FISHING
TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

FISH AND GAME (FISHING REGULATIONS).
W70-00212 06E

COMMERCIAL FISHING AND MUSSEL LICENSES.
W70-00378 06E

COMMON LAW
WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN FLOATABLE STREAMS.
W70-00315 06E

COMPACTION
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

COMPENSATION
EMINENT DOMAIN AND WATER LAW,
W70-00070 06E

THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
W70-00071 06E

EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

PROBLEMS OF VALUATION AND THE MILLER RULE,
W70-00077 06E

THE 'POSSIBILITY OF COMBINATION' RULE EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
W70-00078 06E

NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
W70-00079 06E

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.
W70-00092 04A

COMPRESSIVE STRENGTH
FAILURE OF FRACTURED ROCK,
W70-00350 08E

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

COMPUTATION
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

COMPUTER MODELS
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

COMPUTER PROGRAMS
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

CONCRETE ADDITIVES
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

CONCRETE CONSTRUCTION
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08P

CONCRETE DAMS
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND NORROW POINT DAMS,
W70-00335 08A

CONCRETE LININGS
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08P

CONCRETE TECHNOLOGY
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

CONCRETE TESTING
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

CONDEMNATION
EMINENT DOMAIN AND WATER LAW,
W70-00070 06E

CONDEMNATION FOR PUBLIC PROGRAMS,
W70-00075 06E

THE 'RIVER' CASES,
W70-00076 06E

ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.
W70-00089 04A

CONDEMNATION BY COUNTY OR CITY FOR FLOOD CONTROL.
W70-00101 06E

RIVER IMPROVEMENTS BY THE UNITED STATES.
W70-00134 06E

SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).
W70-00188 03E

FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
W70-00342 06E

CONDEMNATION VALUE
PROBLEMS OF VALUATION AND THE MILLER RULE,
W70-00077 06E

NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
W70-00079 06E

LOMBARD PARK DIST V CHICAGO TITLE AND TRUST CO (AUTHORITY TO MAP FLOOD PLAIN ZONING).
W70-00095 06E

CONDUCTORS
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

CONFERENCES
SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

CONFINEMENT PENS
THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
W70-00062 05C

CONJUNCTIVE USE
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

CONNATE WATER
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

CONSERVATION
WABASH VALLEY COMPACT.
W70-00193 04D

ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
W70-00414 06B

CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
W70-00415 03D

CONSOLIDATION
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

CONSTRUCTION
INDIANA PORT COMMISSION.
W70-00116 06E

PORT AUTHORITIES.
W70-00194 04A

LEVEE CONSTRUCTION AND MAINTENANCE.
W70-00367 04A

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
W70-00398 04A

CONSTRUCTION COSTS
WATER LEVEL PROTECTION (LAKES).
W70-00127 04A

CONSUMPTIVE USE
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

CONTROL STRUCTURES
FLOOD CONTROL AND WATER USAGE.
W70-00189 04A

CONTROL SYSTEMS
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

CONVECTION CIRCULATIONS
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

CONVECTION CURRENTS
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

CONVERTERS(ELECTRICAL)
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

COOLANTS
INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

COOLING TOWER
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

STRUCTURAL DESIGN PHILOSOPHY,
W70-00144 08A

CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

COOLING TOWERS
ECONOMIC SIZING OF COOLING TOWERS,
W70-00155 05D

USUAL APPLICATIONS OF COOLING TOWERS,

COO-DES
W70-00157 05D

HYPERBOLIC COOLING TOWERS,
W70-00291 08A

PHILOSOPHY OF FAILURE,
W70-00294 08A

MATHEMATICAL ASPECTS,
W70-00295 08A

VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

SOME AERODYNAMIC PROBLEMS OF GROUPED COOLING TOWERS,
W70-00298 08A

COMBINED CONDENSER COOLING SYSTEM UPS PLANT AVAILABILITY,
W70-00300 05G

W70-00300 05G

RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
W70-00316 05D

REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
W70-00320 05D

STATUS OF BIG COOLING TOWERS,
W70-00321 08A

COOLING WATER
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
W70-00159 05D

OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS,
W70-00160 05F

TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
W70-00302 04B

CORES
THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
W70-00271 05C

CORIOLIS FORCE
CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

CORRELATION ANALYSIS
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

CORROSION
QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
W70-00046 08G

TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

CORROSION TESTS
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

COST ANALYSIS
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
W70-00162 05E

COSTS
DRAIN IMPROVEMENT.
W70-00133 06E

CRITICAL PATH METHOD
A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

CROP RESIDUES
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

CROSSFLOW COOLING TOWER
REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
W70-00320 05D

CROSS-FLOW DESIGN
STATUS OF BIG COOLING TOWERS,
W70-00321 08A

CUBA
THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

CULTURAL EUTROPHY
DEATH OF A LAKE,
W70-00264 05C

CULTURES
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

CURING COMPOUNDS
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

CURRENTS(WATER)
CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

CYANOPHYTA
CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

DAM FOUNDATIONS
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

DAMAGES
THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
W70-00071 06E

UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
W70-00096 06E

JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
W70-00104 04C

UTILITIES AND INDUSTRIES CORP V STATE (EMINENT DOMAIN).
W70-00238 06E

HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).
W70-00372 06E

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
W70-00389 04A

DAMS
RIPARIAN RIGHTS - REASONABLE USE THEORY.
W70-00083 04A

FISH LADDERS - REGULATIONS.
W70-00118 06E

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

EMINENT DOMAIN.
W70-00329 06E

THE SLIDING STABILITY OF DAMS,
W70-00347 08A

DATA PRESENTATION
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

DATA PROCESSING
WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1968.
W70-00138 07C

DEBRIS AVALANCHES
EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

DECOMPOSING ORGANICS
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

DECOMPOSITION(AEROBIC)
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

DECOMPOSITION(ANAEROBIC)
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

DELAWARE
SPORT FISHING.
W70-00409 06E

W70-00410 06E

W70-00411 06E

W70-00412 06E

DELEGATION DOCTRINE
MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
W70-00187 06E

DENSITY CURRENTS
HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
W70-00319 08B

DESIGN CRITERIA
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

DESIGN STANDARDS
CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

DESTRUCTIVE TESTS
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

DIAGENESIS
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

DIAGONAL TENSION
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
W70-00328 08F

DIAMOND DRILLING
DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

DIATOMS
THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
W70-00271 05C

DIFFUSION
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
W70-00150 05C

DIGITAL COMPUTERS
THE MECHANICS OF SURFACE RUNOFF,
W70-00055 02E

ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

DIRECT CURRENT
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

DISCHARGE(WATER)
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

DISPERSION
DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
W70-00068 02L

DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
W70-00210 08B

SPREAD OF BUOYANT JETS AT THE FREE SURFACE,
W70-00232 08B

DIVERSION
A NEW METHOD OF IRRIGATION,
W70-00090 03F

DOMESTIC WATER
RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

DRAINAGE
EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.
W70-00092 04A

CHICAGO SANITARY DISTRICT.
W70-00172 05G

GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
W70-00176 04C

PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

DRAINAGE BOARDS
INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
W70-00131 06E

DRAINAGE DISTRICTS
ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.
W70-00387 04A

DRAINAGE DISTRICTS EMBRACING PART OR WHOLE OF CITY OR TOWN.
W70-00390 04A

ORGANIZATION OF DRAINAGE DISTRICTS.
W70-00408 04A

DRAINAGE EFFECTS
GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
W70-00176 04C

DRAINAGE ENGINEERING
CONSTRUCTION OF DRAINS.
W70-00132 06E

DRAINAGE IMPROVEMENT DISTRICTS REMOVAL OF STREAM OBSTRUCTIONS.
W70-00225 04A

DRAINAGE PRACTICES
INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
W70-00131 06E

GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
W70-00176 04C

SPORT FISHING.
W70-00412 06E

DRAINAGE PROGRAMS
INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
W70-00131 06E

CONSTRUCTION OF DRAINS.
W70-00132 06E

PLANS OF RECLAMATION.
W70-00396 04A

DRAINAGE SYSTEMS
SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00113 06E

PROTECTION OF LAKES.
W70-00123 04A

WATER LEVEL PROTECTION.
W70-00124 04A

WATER LEVEL PROTECTION (LAKES).
W70-00127 04A

DRAIN IMPROVEMENT.
W70-00133 06E

CHICAGO SANITARY DISTRICT.
W70-00171 05G

W70-00173 05G

W70-00174 05G

W70-00175 05G

EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

DRAINAGE WATER
ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).
W70-00169 04A

DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

DRAINS
CONSTRUCTION OF DRAINS.
W70-00132 06E

SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00190 04C

DRILL HOLES
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

DRILLING
WATER WELL DRILLERS.
W70-00179 04B

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

DROUGHTS
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

DRYDOCKS
UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
W70-00096 06E

DRYING
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

DUNES
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

DYNAMIC PROGRAMMING
AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

EARTH PRESSURE
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

EARTHQUAKE FORECASTING
THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
W70-00333 08E

EARTHQUAKES
THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
W70-00333 08E

EARTHWORKS
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

ECOLOGY
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS.
W70-00140 06G

CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

ECONOMIC DEVELOPMENT
CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
W70-00415 03D

ECONOMIC EFFICIENCY
INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

ECONOMIC GROWTH
RECENT DEVELOPMENTS IN FISHING METHODS AND EFFECTS OF MANAGEMENT ON EFFICIENCY,
W70-00413 06B

ECONOMICS
BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
W70-00139 03A

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

ECONOMICS OF COOLING TOWERS
HYPERBOLIC COOLING TOWERS,
W70-00291 08A

ECOSYSTEMS
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

ELECTRIC CABLES
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

ELECTRIC CONVERTER VALVES
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

ELECTRIC CURRENTS
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

ELECTRIC POWER PLANT
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
W70-00159 05D

ELECTRICAL STUDIES
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

ELECTRODIALYSIS
BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
W70-00139 03A

ELLESMERE ISLAND
RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

EMINENT DOMAIN
EMINENT DOMAIN AND WATER LAW,
W70-00070 06E

THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
W70-00071 06E

EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

PRIVATE UNDERTAKINGS AS PUBLIC USES,
W70-00073 06E

MUNICIPAL WATER SUPPLIES,
W70-00074 06E

CONDEMNATION FOR PUBLIC PROGRAMS,
W70-00075 06E

THE 'RIVER' CASES,
W70-00076 06E

PROBLEMS OF VALUATION AND THE MILLER RULE,
W70-00077 06E

THE 'POSSIBILITY OF COMBINATION' RULE EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
W70-00078 06E

NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
W70-00079 06E

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

THE SERVITUDE DOCTRINE THE DOCTRINE UNDER ENGLISH LAW,
W70-00081 06E

THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.
W70-00092 04A

UTILITIES AND INDUSTRIES CORP V STATE (EMINENT DOMAIN).
W70-00238 06E

EMINENT DOMAIN.
W70-00329 06E

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).
W70-00379 06G

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
W70-00398 04A

ENGINEERING
ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.
W70-00387 04A

ENGINEERING STRUCTURES
CHICAGO SANITARY DISTRICT.
W70-00173 05G

ENTRAINMENT
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
W70-00319 08B

ENTRAINMENT COEFFICIENT
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

ENVIRONMENT
ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
W70-00014 06B

ENVIRONMENTAL SANITATION
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

SANITATION DISTRICTS.
W70-00399 05G

EPHEMERAL STREAMS
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

EQUATORIAL ATLANTIC CURRENT
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

EQUITABLE WATER DISTRIBUTION
A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
W70-00184 06D

EROSION
SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
W70-00250 02J

GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT,

EASTERN HUNUA RANGES,
W70-00254 02J

EROSION CONTROL
DRAINS AND LEVEES AFFECTING HIGHWAYS.
W70-00011 04C

REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
W70-00392 04D

ARKANSAS FORESTRY COMMISSION.
W70-00407 04D

ESTHWAITE WATER(ENGLAND)
THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
W70-00271 05C

ESTUARIES
SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
W70-00068 02L

EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
W70-00158 05C

WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

ESTUARINE FISHERIES
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

EUPHOTIC ZONE
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

EUTROPHICATION
DEATH OF A LAKE,
W70-00264 05C

SOME ASPECTS OF THE EUTROPHICATION OF WATER,
W70-00266 05C

CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

EVALUATION
A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

EVAPOTRANSPIRATION
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

EVAPOTRANSPIRATION CONTROL
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

EVERGLADES
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

EXPANSIVE CLAYS
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

EXPANSIVE SOILS
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

EXTRA HIGH VOLTAGE
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

FABRIFORM METHOD
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

FACINGS
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

FAILURE(MECHANICS)
FAILURE OF FRACTURED ROCK,
W70-00350 08E

FARM WASTES
THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
W70-00062 05C

FEDERAL GOVERNMENT
CONDEMNATION FOR PUBLIC PROGRAMS,
W70-00075 06E

THE 'RIVER' CASES,
W70-00076 06E

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

THE SERVITUDE DOCTRINE THE DOCTRINE UNDER ENGLISH LAW,
W70-00081 06E

NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

POLLUTION CONTROL AMENDMENTS URGED.
W70-00086 05G

WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.
W70-00091 04C

UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
W70-00096 06E

ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
W70-00406 04A

FEDERAL POWER ACT
THE 'POSSIBILITY OF COMBINATION' RULE EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
W70-00078 06E

FEDERAL-STATE COOPERATION
STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

FENCES
FENCES ON OVERFLOWED LANDS.
W70-00369 06E

FERRIES
FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

INDIANA STATE TOLL BRIDGE COMMISSION.
W70-00111 06E

FERRIES ON STREAMS WITHIN STATE.
W70-00352 06E

FERRY REGULATION
FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

FERRYBRIDGE COOLING TOWER
PHILOSOPHY OF FAILURE,
W70-00294 08A

FERRYBRIDGE POWER STATION
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

FERTILIZERS
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

FIELD TESTS
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

FINANCING
INDIANA PORT COMMISSION.
W70-00116 06E

FLOOD CONTROL SYSTEMS.
W70-00200 04A

SANITATION DISTRICTS.
W70-00402 05G

FISH
FISH AND GAME (FISHING REGULATIONS).
W70-00212 06E

FISH AND GAME.
W70-00385 06E

FISH CONSERVATION
SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).
W70-00188 03E

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).
W70-00379 06G

SPORT FISHING.
W70-00409 06E

W70-00410 06E

W70-00411 06E

W70-00412 06E

FISH HEMATOLOGY
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

FISH LADDERS
FISH LADDERS - REGULATIONS.
W70-00118 06E

FISH MANAGEMENT
SPORT FISHING.
W70-00409 06E

W70-00410 06E

W70-00411 06E

W70-00412 06E

FISH REPRODUCTION
STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

FISH RESTORATION
STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

FISHERIES
RECENT DEVELOPMENTS IN FISHING METHODS AND EFFECTS OF MANAGEMENT ON EFFICIENCY,
W70-00413 06B

FISHING
FISHING THROUGH ICE HOLES.
W70-00117 06E

FISH AND WILDLIFE RESOURCES.
W70-00199 03E

ANGLING LAWS.
W70-00383 06E

FISH AND GAME.
W70-00385 06E

FISHING GEAR
FISH AND WILDLIFE RESOURCES.
W70-00199 03E

ANGLING LAWS.
W70-00383 06E

FISHING RIGHTS
SPORT FISHING.
W70-00412 06E

FISHKILL
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

FLOATING
WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

FLOOD CONTROL
CONDEMNATION BY COUNTY OR CITY FOR FLOOD CONTROL.
W70-00101 06E

MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.
W70-00129 06E

CONSERVATION DEPARTMENT.
W70-00136 06E

CHICAGO SANITARY DISTRICT.
W70-00175 05G

FLOOD CONTROL AND WATER USAGE.
W70-00189 04A

LEVEE AUTHORITY DISTRICTS.
W70-00197 04A

FLOOD CONTROL SYSTEMS.
W70-00200 04A

INVESTIGATION OF BRAHMAPUTRA RIVER,
W70-00219 02E

LEVEE CONSTRUCTION AND MAINTENANCE.
W70-00367 04A

CONSTRUCTION OF LEVEES AND FLOOD CONTROL PROJECTS.
W70-00398 04A

FLOOD PREVENTION.
W70-00405 04A

ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
W70-00406 04A

FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
W70-00416 06B

FLOOD DAMAGE
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
W70-00001 04A

ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS.
W70-00004 04A

FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN.
W70-00008 04A

FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA.
W70-00010 04A

FLOOD PLAIN INFORMATION, WESTFIELD AND LITTLE RIVERS, WESTFIELD, MASSACHUSETTS.
W70-00042 04A

JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
W70-00104 04C

MILLS AND MILL DAMS.
W70-00245 04A

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
W70-00389 04A

FLOOD FORECASTING
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
W70-00226 02E

FLOOD HYDROGRAPHS
FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

FLOOD HYDROLOGY
FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

FLOOD LOSSES
FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
W70-00416 06B

FLOOD PLAIN ZONING
LOMBARD PARK DIST V CHICAGO TITLE AND TRUST CO (AUTHORITY TO MAP FLOOD PLAIN ZONING).
W70-00095 06E

FLOOD PROTECTION
MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.
W70-00129 06E

FLOOD CONTROL AND WATER USAGE.
W70-00189 04A

ARKANSAS FORESTRY COMMISSION.
W70-00407 04D

FLOOD ROUTING
FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
W70-00218 08B

FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

FLOODING
POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.
W70-00384 06E

FLOOD PREVENTION.
W70-00405 04A

FLOODS
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
W70-00001 04A

ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS.
W70-00004 04A

FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN.
W70-00008 04A

FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA.
W70-00010 04A

FLOOD PLAIN INFORMATION, WESTFIELD AND LITTLE RIVERS, WESTFIELD, MASSACHUSETTS.
W70-00042 04A

FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
W70-00218 08B

GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
W70-00254 02J

FLORIDA
ACCRETION - A NEW SLANT,
W70-00170 04A

EXTENT OF PRIVATE RIGHTS IN NONNAVIGABLE LAKES,
W70-00182 04A

PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

FLOW
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00009 02C

ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

INITIATION OF GLACIER SURGES,
W70-00015 02C

WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
W70-00018 02C

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

WHAT ARE GLACIER SURGES,
W70-00022 02C

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
W70-00028 02C

GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

PROPAGATION OF GLACIER SURGES,
W70-00033 02C

A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
W70-00221 02C

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
W70-00319 08B

FLOW MEASUREMENT
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

FLOW PROFILES
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

FOOD QUALITY
THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

FORECASTING
A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
W70-00043 02J

THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
W70-00333 08E

FORESTS
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

FORMWORK(CONSTRUCTION)
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

FOUNDATION INVESTIGATIONS
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

FOUNDATION ROCKS
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

FRESH WATER
DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
W70-00068 02L

FRESHWATER FISH
ANGLING LAWS.
W70-00383 06E

FRICTION
A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
W70-00221 02C

FROST ACTION
MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

FULVIC ACIDS
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

FUTURE PLANNING
A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
W70-00184 06D

GALLOPING CONDUCTORS
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

GAS EFFLUENT
SEA PLANTS FOR FOOD,
W70-00161 03C

GEOLOGIC INVESTIGATIONS
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

GEOLOGIC MAPPING
LOMBARD PARK DIST V CHICAGO TITLE AND TRUST CO (AUTHORITY TO MAP FLOOD PLAIN ZONING).
W70-00095 06E

GEOMORPHOLOGY
GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
W70-00254 02J

GEOPHYSICS
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

GEORGIA
A NEW METHOD OF IRRIGATION,
W70-00090 03F

RIPARIAN RIGHTS IN GEORGIA,
W70-00183 04A

GEOTHERMAL STUDIES
RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

GLACIAL DRIFT
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

GLACIAL SOILS
MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
W70-00166 02C

GLACIAL TILL
A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
W70-00166 02C

GLACIATION
A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
W70-00166 02C

GLACIER SURGES
THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

PROPAGATION OF GLACIER SURGES,
W70-00033 02C

GLACIERS
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00009 02C

ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

INITIATION OF GLACIER SURGES,
W70-00015 02C

WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

WHAT ARE GLACIER SURGES,
W70-00022 02C

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
W70-00028 02C

GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

PROPAGATION OF GLACIER SURGES,
W70-00033 02C

A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
W70-00221 02C

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

GRASSLANDS
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

GREAT BRITAIN
SOME ASPECTS OF THE EUTROPHICATION OF WATER,
W70-00266 05C

GROUND CURRENTS
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

GROUND RETURN
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

GROUNDWATER
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

THE GROUNDWATER SITUATION IN OHIO,
W70-00203 02F

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

SALTWATER INTRUSION IN THE UNITED STATES.
W70-00211 02F

STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
W70-00249 02F

GROUNDWATER BASINS
NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
W70-00248 02F

GROUNDWATER FLOW
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

GROUNDWATER MOVEMENT
SALTWATER INTRUSION IN THE UNITED STATES.
W70-00211 02F

NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
W70-00249 02F

A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

GROUND-WATER RECHARGE
TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
W70-00302 04B

GROWTH
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

GULF OF ALASKA
WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

GUYED TOWERS
SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

HEAT BUDGET
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

HEAT FLOW
RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

HEAT TRANSFER
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
W70-00158 05C

HEATED DISCHARGES
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE

THAMES ESTUARY - II,
W70-00158 05C

HIGHWAY PROTECTION
DRAINS AND LEVEES AFFECTING HIGHWAYS.
W70-00011 04C

HIGHWAYS
DRAINS AND LEVEES AFFECTING HIGHWAYS.
W70-00011 04C

HIGHWAYS, BRIDGES, AND FERRIES-PROVISIONS FOR PARTICULAR COUNTIES.
W70-00094 06E

BRIDGES OVER CANALS.
W70-00355 04A

INTERSTATE BRIDGES.
W70-00376 04A

HUMIC ACIDS
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

HYDRATES
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

HYDRAULIC DESIGN
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

HYDRAULIC JUMP
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

HYDRAULIC MODELS
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
W70-00003 08B

WATERSHED HYDRAULICS IN THE LABORATORY,
W70-00065 02A

TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

HYDRAULICS
DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

HYDROELECTRIC PLANTS
PROBLEMS OF THE PROTECTION OF WATER IN CONNECTION WITH THE BUILDING OF WATER-POWER PLANTS (IN GERMAN),
W70-00292 05G

HYDROGEOLOGY
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
W70-00067 02L

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

HYDROGRAPH ANALYSIS
GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

HYDROGRAPHS
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

HYPERBOLIC COOLING TOWERS
HYPERBOLIC COOLING TOWERS,
W70-00291 08A

HYPERTROPHIC WATERS
CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

ICE CAPS
ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

ICE FISHING
FISHING THROUGH ICE HOLES.
W70-00117 06E

ICELAND
GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

ILLINOIS
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
W70-00001 04A

EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

MCCUE V CARLTON (TITLE TO ACCRETIONS).
W70-00061 06E

LOMBARD PARK DIST V CHICAGO TITLE AND TRUST CO (AUTHORITY TO MAP FLOOD PLAIN ZONING).
W70-00095 06E

INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
W70-00114 06E

CHICAGO SANITARY DISTRICT.
W70-00171 05G

CHICAGO REGIONAL PORT COMMISSION.
W70-00192 04A

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

DRAINAGE IMPROVEMENT DISTRICTS REMOVAL OF STREAM OBSTRUCTIONS.
W70-00225 04A

JOINT CONSTRUCTION OF WATER SUPPLY.
W70-00371 03D

SENECA PORT DISTRICT.
W70-00393 04A

SOIL AND WATER CONSERVATION DISTRICTS LAW.
W70-00403 03D

ORGANIZATION OF DRAINAGE DISTRICTS.
W70-00408 04A

IMIDAZOLINE DERIVATIVES
PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
W70-00275 05C

IMPERVIOUS LININGS
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

IN SITU TESTS
THE SLIDING STABILITY OF DAMS,
W70-00347 08A

INDIA
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

INDIAN OCEAN
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

INDIANA
DRAINS AND LEVEES AFFECTING HIGHWAYS.
W70-00011 04C

POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
W70-00093 05G

COUNTY BRIDGE CONSTRUCTION.
W70-00108 06E

TOWNSHIPS AND COUNTY LINE BRIDGES.
W70-00109 06E

FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

INDIANA STATE TOLL BRIDGE COMMISSION.
W70-00111 06E

PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
W70-00112 03E

SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00113 06E

INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
W70-00114 06E

REGISTRATION OF MOTORBOATS.
W70-00115 06E

INDIANA PORT COMMISSION.
W70-00116 06E

FISHING THROUGH ICE HOLES.
W70-00117 06E

FISH LADDERS - REGULATIONS.
W70-00118 06E

MUSSELS - REGULATIONS.
W70-00119 06E

OPEN SEASON AND BAG LIMITS.
W70-00120 06E

STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

WATERCOURSES - CANALS - TOLL BRIDGES.
W70-00122 06E

PROTECTION OF LAKES.
W70-00123 04A

WATER LEVEL PROTECTION.
W70-00124 04A

W70-00125 04A

WATER LEVEL STABILIZATION.
W70-00126 04A

WATER LEVEL PROTECTION (LAKES).
W70-00127 04A

STUDY OF WATER RESOURCES AND MANAGEMENT.
W70-00128 06B

MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.
W70-00129 06E

RESERVOIR SITES FOR STORAGE OF WATER.
W70-00130 06E

INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
W70-00131 06E

CONSTRUCTION OF DRAINS.
W70-00132 06E

DRAIN IMPROVEMENT.
W70-00133 06E

RIVER IMPROVEMENTS BY THE UNITED STATES.
W70-00134 06E

DUTIES OF THE DEPARTMENT OF CONSERVATION.
W70-00135 05G

CONSERVATION DEPARTMENT.
W70-00136 06E

WATER WELL DRILLERS.
W70-00179 04B

RIVERS STREAMS AND WATERWAYS.
W70-00186 05G

SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00190 04C

NAVIGABLE WATERWAYS.
W70-00191 04A

CHICAGO REGIONAL PORT COMMISSION.
W70-00192 04A

WABASH VALLEY COMPACT.
W70-00193 04D

PORT AUTHORITIES.
W70-00194 04A

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

OHIO RIVER AREA COORDINATING COMMISSION.
W70-00196 06B

LEVEE AUTHORITY DISTRICTS.
W70-00197 04A

WATER RIGHTS.
W70-00198 04C

COUNTY LINE BRIDGES.
W70-00336 04A

FERRIES ON STREAMS WITHIN STATE.
W70-00352 06E

TOWNSHIP LINE BRIDGES.
W70-00354 04A

BRIDGES OVER CANALS.
W70-00355 04A

PUBLIC PARKS-WATERS-POWERS OF THE BOARD.
W70-00366 06E

LEVEE CONSTRUCTION AND MAINTENANCE.
W70-00367 04A

FENCES ON OVERFLOWED LANDS.
W70-00369 06E

FISH AND GAME (LICENSES).
W70-00370 06E

INTERSTATE BRIDGES.
W70-00373 04A

W70-00374 04A

W70-00375 04A

W70-00376 04A

W70-00377 04A

COMMERCIAL FISHING AND MUSSEL LICENSES.
W70-00378 06E

OHIO VALLEY COMPACT.
W70-00380 06B

STREAMS AND WATERS.
W70-00381 05G

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
W70-00392 04D

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
W70-00395 04A

FLOOD PREVENTION.
W70-00405 04A

INFILTRATION
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

INSTRUMENTATION
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

INTERNATIONAL LAW
TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
W70-00180 04A

INTERNATIONAL WATERS
INVESTIGATION OF BRAHMAPUTRA RIVER,
W70-00219 02E

INTERSTATE BRIDGES
INTERSTATE BRIDGES.
W70-00373 04A

W70-00374 04A

W70-00375 04A

W70-00376 04A

W70-00377 04A

INTERSTATE COMMISSIONS
INTERSTATE WATER SANITATION BOARD.
W70-00107 05G

INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
W70-00114 06E

WABASH VALLEY COMPACT.
W70-00193 04D

INTERSTATE BRIDGES.
W70-00374 04A

W70-00375 04A

OHIO RIVER VALLEY WATER SANITATION COMPACT.
W70-00391 05G

INTERSTATE COMPACTS
INTERSTATE WATER SANITATION BOARD.
W70-00107 05G

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.
W70-00178 05G

OHIO VALLEY COMPACT.
W70-00380 06B

OHIO RIVER VALLEY WATER SANITATION COMPACT.
W70-00391 05G

INTERSTATE RIVERS
INDIANA STATE TOLL BRIDGE COMMISSION.
W70-00111 06E

INTERSTATE BRIDGES.
W70-00373 04A

W70-00377 04A

INVERSE CONDEMNATION
THE 'RIVER' CASES,
W70-00076 06E

ION EXCHANGE
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

IOWA
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
W70-00001 04A

IOWA NATURAL RESOURCES COUNCIL V MAPES (INJUNCTIVE ABATEMENT OF AN UNAUTHORIZED STREAM OBSTRUCTION).

W70-00097 06E

ANGLING LAWS.
W70-00383 06E

OIL AND GAS WELLS--DECLARATION OF POLICY.
W70-00386 05G

ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.
W70-00387 04A

RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
W70-00388 04A

DRAINAGE DISTRICTS EMBRACING PART OR WHOLE OF CITY OR TOWN.
W70-00390 04A

IRISH SEA
CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
W70-00202 02L

IRON OXIDES
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

ISOLATION
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

JAPAN
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

JETS
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

SPREAD OF BUOYANT JETS AT THE FREE SURFACE,
W70-00232 08B

PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW,
W70-00318 08B

JOINT PROJECTS
SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00113 06E

JOINTS(GEOLOGY)
STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
W70-00249 02F

JUDICIAL DECISIONS
PRIVATE UNDERTAKINGS AS PUBLIC USES,
W70-00073 06E

THE 'RIVER' CASES,
W70-00076 06E

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

JURISDICTION
ORGANIZATION OF DRAINAGE DISTRICTS.
W70-00408 04A

KARAKORAM
GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

KENTUCKY
CONDEMNATION BY COUNTY OR CITY FOR FLOOD CONTROL.
W70-00101 06E

STATE PLANNING MISCELLANEOUS PROJECTS.
W70-00105 06E

FISH AND WILDLIFE RESOURCES.
W70-00106 06E

INTERSTATE WATER SANITATION BOARD.
W70-00107 05G

STRIP MINING.
W70-00177 05G

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.
W70-00178 05G

FLOOD CONTROL AND WATER USAGE.
W70-00189 04A

FISH AND WILDLIFE RESOURCES.
W70-00199 03E

FLOOD CONTROL SYSTEMS.
W70-00200 04A

JOINT OPERATION OF WATER SOURCES.
W70-00276 03D

BRIDGES, CULVERTS, SEWERS AND WATERCOURSES IN SECOND CLASS CITIES.
W70-00301 06E

ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.
W70-00304 03D

EMINENT DOMAIN.
W70-00329 06E

POWER TO ACQUIRE CONTROL AND DISPOSE OF PROPERTY.
W70-00364 06E

WATERSHED CONSERVANCY DISTRICTS.
W70-00368 04D

OHIO RIVER VALLEY WATER SANITATION COMPACT.
W70-00391 05G

OIL, GAS, AND SALT WATER WELLS.
W70-00394 05G

SANITATION DISTRICTS.
W70-00399 05G

W70-00400 05G

W70-00401 05G

W70-00402 05G

KINETIC ENERGY
RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
W70-00316 05D

KINETICS
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

LABORATORY TESTS
SEDIMENT MEASUREMENT TECHNIQUES F. LABORATORY PROCEDURES,
W70-00215 02J

PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

LAKE AGING
DEATH OF A LAKE,
W70-00264 05C

LAKE CHANGES
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

LAKE MICHIGAN
CHICAGO REGIONAL PORT COMMISSION.
W70-00192 04A

LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
W70-00263 05B

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
W70-00392 04D

LAKE PONTCHARTRAIN(LA)
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

LAKE SHORES
WATER LEVEL PROTECTION.
W70-00125 04A

LAKE WASHINGTON(WASH)
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

LAKES
EXTENT OF PRIVATE RIGHTS IN NONNAVIGABLE LAKES,
W70-00182 04A

DEATH OF A LAKE,
W70-00264 05C

CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

LAND
MISSISSIPPI RIVER PARKWAY.
W70-00100 06E

LAND RECLAMATION
PLANS OF RECLAMATION.
W70-00396 04A

LAND TENURE
EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

ACCRETION - A NEW SLANT,
W70-00170 04A

FENCES ON OVERFLOWED LANDS.
W70-00369 06E

LAND USE
ACQUISITION OF STATE LANDS BY THE FEDERAL GOVERNMENT.
W70-00406 04A

LAND VALUE
FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
W70-00416 06B

LANDFILLS
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,

LAN-MAT
W70-00006 05E

LANDSLIDES
A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
W70-00003 08B

MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

LATENT HEAT
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

LEACHING
DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

LEAF NODULES
NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
W70-00280 02K

LEAKAGE
A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

LEASES
PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
W70-00112 03E

LEGAL ASPECTS
REGISTRATION OF MOTORBOATS.
W70-00115 06E

LEGISLATION
POLLUTION CONTROL AMENDMENTS URGED.
W70-00086 05G

A STATE STATUTE TO PROVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
W70-00184 06D

WATER LEGISLATION,
W70-00185 06D

LEGUMES
INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
W70-00286 02K

INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

LEVEES
LEVEE AUTHORITY DISTRICTS.
W70-00197 04A

LEVEE CONSTRUCTION AND MAINTENANCE.
W70-00367 04A

LICENSES
COMMERCIAL FISHING AND MUSSEL LICENSES.
W70-00378 06E

LIGHTNING
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

LIGHTNING SURGES
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

LIMESTONES
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

LIMNOLOGY
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
W70-00293 05C

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

LITTORAL DRIFT
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

LOADING TESTS
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

LOCAL GOVERNMENTS
HIGHWAYS, BRIDGES, AND FERRIES-PROVISIONS FOR PARTICULAR COUNTIES.
W70-00094 06E

COUNTY BRIDGE CONSTRUCTION.
W70-00108 06E

TOWNSHIPS AND COUNTY LINE BRIDGES.
W70-00109 06E

DRAIN IMPROVEMENT.
W70-00133 06E

RIVERS STREAMS AND WATERWAYS.
W70-00186 05G

SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00190 04C

COUNTY LINE BRIDGES.
W70-00336 04A

TOWNSHIP LINE BRIDGES.
W70-00354 04A

PUBLIC PARKS-WATERS-POWERS OF THE BOARD.
W70-00366 06E

CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
W70-00382 05E

FLOOD PREVENTION.
W70-00405 04A

LOESS
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

LOUISIANA
HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).
W70-00372 06E

MACROMOLECULAR ORGANIC MATTER
INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

MAINE
SMITH V SPEERS (CONDEMNATION OF PROPERTY FOR CONSERVATION OF ATLANTIC SEA RUN SALMON).
W70-00188 03E

MANAGEMENT
RECENT DEVELOPMENTS IN FISHING METHODS AND EFFECTS OF MANAGEMENT ON EFFICIENCY,
W70-00413 06B

MANGANESE
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

MAN-MADE LAKES
CONSERVATION DEPARTMENT.
W70-00136 06E

MARINE DESERTS
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

MARINE PLANTS
SEA PLANTS FOR FOOD,
W70-00161 03C

MARKOV PROCESSES
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

MARYLAND
GIANT FOOD INC V WASHINGTON-ROCKVILLE INDUSTRIAL PARK INC (DAMAGES FROM DRAINAGE).
W70-00176 04C

MASS TRANSFER
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN),
W70-00147 05C

MASS WASTING
MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

MATERIALS CONTROL
OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

MATERIALS TESTING
OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

MATHEMATICAL MODELS
A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
W70-00043 02J

THE MECHANICS OF SURFACE RUNOFF,
W70-00055 02E

MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN),
W70-00147 05C

A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
W70-00226 02E

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

MATHEMATICAL STUDIES
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
W70-00210 08B

DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

MATHEMATICAL ASPECTS,
W70-00295 08A

MEANDERS
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

MEASUREMENT
SEDIMENT MEASUREMENT TECHNIQUES A. FLUVIAL SEDIMENT,
W70-00214 02J

EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

MELTING
GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

METABOLISM
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

METEOROLOGICAL DATA
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

MICHIGAN
WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN FLOATABLE STREAMS.
W70-00315 06E

MICROBIAL STRAINS
AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
W70-00286 02K

INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

MICROCYSTIS AERUGINOSA
CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

MIGRATORY BIRDS
STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

MILL DAMS
MILLS AND MILL DAMS.
W70-00245 04A

MINE DRAINAGE
STRIP MINING.
W70-00177 05G

MINNESOTA
ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.
W70-00089 04A

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
W70-00397 05G

MISSISSIPPI RIVER
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA.
W70-00001 04A

RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
W70-00388 04A

MISSOURI
JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
W70-00104 04C

WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.
W70-00345 06E

CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
W70-00382 05E

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
W70-00389 04A

MIXING
SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),
W70-00151 05G

MODEL STUDIES
A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
W70-00003 08B

MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

WATERSHED HYDRAULICS IN THE LABORATORY,
W70-00065 02A

THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
W70-00250 02J

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

MODEL TESTING
VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

MODEL TESTS
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND NORROW POINT DAMS,
W70-00335 08A

MOLLUSKS
FISH AND GAME (MUSSELS)
W70-00236 06E

MONTE CARLO METHOD
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

MONTEREY CHANNEL
THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

MORAINES
A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
W70-00166 02C

MORPHOLOGY(BLOOD)
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

MOUSCRON
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

MUCK SOILS
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

MULTIAXIAL TESTS
FAILURE OF FRACTURED ROCK,
W70-00350 08E

MULTIPLE-PURPOSE RESERVOIRS
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

MUNICIPAL WASTES
ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A PILOT STUDY OF TREATING COMBINED CHROME TANNERY WASTES AND

MUN-NIT

DOMESTIC SEWAGE.
W70-00163 05D

MUNICIPAL WATER
MUNICIPAL WATER SUPPLIES,
W70-00074 06E

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
W70-00308 05F

RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

MUSSELS
MUSSELS - REGULATIONS.
W70-00119 06E

FISH AND GAME (MUSSELS)
W70-00236 06E

NATURAL DRAFT TOWERS
ECONOMIC SIZING OF COOLING TOWERS,
W70-00155 05D

NATURAL FLOW
IOWA NATURAL RESOURCES COUNCIL V MAPES (INJUNCTIVE ABATEMENT OF AN UNAUTHORIZED STREAM OBSTRUCTION).
W70-00097 06E

NATURAL RESOURCES
CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
W70-00415 03D

NATURAL WATERBODIES
DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

NAVIGABLE RIVERS
BOERNER V MCCALLISTER (NAVIGABLE STREAMS).
W70-00099 06E

RIVER IMPROVEMENTS BY THE UNITED STATES.
W70-00134 06E

EROSION CONTROL AND IMPROVEMENT OF NAVIGABLE WATERS.
W70-00392 04D

NAVIGABLE WATERCOURSES
NAVIGABLE WATERWAYS.
W70-00191 04A

NAVIGABLE WATERS
NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
W70-00079 06E

THE SERVITUDE DOCTRINE THE DOCTRINE UNDER ENGLISH LAW,
W70-00081 06E

THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

EMINENT DOMAIN - WATERS AND WATERCOURSE'S INTERFERENCE WITH DRAINAGE FROM LAND ON NON-NAVIGABLE TRIBUTARY CAUSED BY GOVERNMENT DAM ON NAVIGABLE RIVER HELD COMPENSABLE UNDER FIFTH AMENDMENT.
W70-00092 04A

UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
W70-00096 06E

MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
W70-00187 06E

WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN FLOATABLE STREAMS.
W70-00315 06E

WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.
W70-00345 06E

SENECA PORT DISTRICT.
W70-00393 04A

NAVIGATION
NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
W70-00180 04A

NAVIGABLE WATERWAYS.
W70-00191 04A

ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.
W70-00304 03D

NAVIGATIONAL SERVITUDE
THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

NAVIGATIONAL SERVITUDES
NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

NETWORK DESIGN
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

NEW HAMPSHIRE
FISH AND GAME.
W70-00385 06E

NEW JERSEY
ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).
W70-00169 04A

NEW SOUTH WALES(AUSTRALIA)
GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

NEW YORK
SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).
W70-00103 06E

UTILITIES AND INDUSTRIES CORP V STATE (EMINENT DOMAIN).
W70-00238 06E

NEW ZEALAND
GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
W70-00254 02J

GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

NITRIFICATION
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

NITROGEN
BIOLOGY AND ECOLOGY OF NITROGEN.
W70-00277 02K

THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

NITROGEN CYCLE
AMMONIA NITROGEN LOSSES FROM STREAMS,
W70-00267 05G

BIOLOGY AND ECOLOGY OF NITROGEN.
W70-00277 02K

THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

NITROGEN FIXATION
BIOLOGY AND ECOLOGY OF NITROGEN.
W70-00277 02K

THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
W70-00280 02K

INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR

SYMBIOSIS WITH SEVERAL LEGUMES,
W70-00286 02K

NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

NITROGEN FIXATION(NONSYMBIOTIC)
NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

NITROGEN LOSS
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

NITROGEN RETENTION
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

NITROGEN(INDUSTRIAL)
INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

NONPHYTOTOXIC CHEMICALS
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

NON-NAVIGABLE WATERS
RIPARIAN RIGHTS IN GEORGIA,
W70-00183 04A

NON-RIPARIAN USES
NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

NORTHUMBERLAND STRAIT(CANADA)
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

NUISANCE(PRIVATE)
TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

NUISANCE(PUBLIC)
TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

NUTRIENT BALANCE
DEATH OF A LAKE,
W70-00264 05C

NUTRIENT BUDGET
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

NUTRIENT CONCENTRATION
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

NUTRIENTS
SOME ASPECTS OF THE EUTROPHICATION OF WATER,
W70-00266 05C

CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

OBSTRUCTION TO FLOW
IOWA NATURAL RESOURCES COUNCIL V MAPES (INJUNCTIVE ABATEMENT OF AN UNAUTHORIZED STREAM OBSTRUCTION).
W70-00097 06E

JURGESON V ROMINE (DAMAGES RESULTING FROM OBSTRUCTING THE FLOW OF A CREEK).
W70-00104 04C

NAVIGABLE WATERWAYS.
W70-00191 04A

DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

DRAINAGE IMPROVEMENT DISTRICTS REMOVAL OF STREAM OBSTRUCTIONS.
W70-00225 04A

OCEAN CIRCULATION
CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
W70-00202 02L

OCEAN CURRENTS
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

OCEANS
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

OHIO
THE GROUNDWATER SITUATION IN OHIO,
W70-00203 02F

OHIO RIVER
OHIO RIVER AREA COORDINATING COMMISSION.
W70-00196 06B

OHIO VALLEY COMPACT.
W70-00380 06B

OIL INDUSTRY
PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
W70-00112 03E

OPEN CHANNEL FLOW
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

OPEN SEASONS
OPEN SEASON AND BAG LIMITS.
W70-00120 06E

OPERATION AND MAINTENANCE
MAINTENANCE OF DAMS, LEVEES AND FLOOD CONTROL WORKS.
W70-00129 06E

OPERATIONS
JOINT OPERATION OF WATER SOURCES.
W70-00276 03D

OPERATIONS RESEARCH
OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

OPTICAL INSTRUMENTS
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

OPTIMIZATION
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

OPTIMUM DEVELOPMENT PLANS
CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
W70-00313 06B

ORGANIC LOADING
PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

ORGANIC MATTER
INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

ORIENTATION
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

OUTLET WORKS
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

OVERFLOW
FENCES ON OVERFLOWED LANDS.
W70-00369 06E

SOMERSET VILLA INC V CITY OF LEE'S SUMMIT (APPORTIONMENT OF FLOOD DAMAGES).
W70-00389 04A

OVERLAND FLOW
FENCES ON OVERFLOWED LANDS.
W70-00369 06E

OWNERSHIP OF BEDS
BOERNER V MCCALLISTER (NAVIGABLE STREAMS).
W70-00099 06E

EXTENT OF PRIVATE RIGHTS IN NONNAVIGABLE LAKES,
W70-00182 04A

WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN

FLOATABLE STREAMS.
W70-00315 06E

WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.
W70-00345 06E

OXIDATION
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

OXYGEN SAG
THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
W70-00148 05C

COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

PAHASAPA FORMATION
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

PAINTING
SYSTEMS APPROACH TO ORGANIC COATINGS,
W70-00358 08G

PAINTS
SYSTEMS APPROACH TO ORGANIC COATINGS,
W70-00358 08G

PALEOCLIMATOLOGY
ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

PARKS
RIVERS STREAMS AND WATERWAYS.
W70-00186 05G

PUBLIC PARKS-WATERS-POWERS OF THE BOARD.
W70-00366 06E

PATH OF POLLUTANTS
INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
W70-00240 05B

PATTERN SEARCH
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

PEAT
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

PENALTIES
FISH AND GAME (FISHING REGULATIONS).
W70-00212 06E

FISH AND GAME (MUSSELS)
W70-00236 06E

PENALTIES(CIVIL)
FISH AND GAME (LICENSES).
W70-00370 06E

SENECA PORT DISTRICT.
W70-00393 04A

PENALTIES(CRIMINAL)
FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

DUTIES OF THE DEPARTMENT OF CONSERVATION.
W70-00135 05G

PENNSYLVANIA
FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA.
W70-00010 04A

PERMEABILITY
PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

PERMITS
SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).
W70-00103 06E

FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

FISH AND GAME (LICENSES).
W70-00370 06E

COMMERCIAL FISHING AND MUSSEL LICENSES.
W70-00378 06E

PHAEODACTYLUM
SEA PLANTS FOR FOOD,
W70-00161 03C

PHOSPHORUS FIXATION
AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
W70-00286 02K

PHOTOGRAPHIC ANALYSIS
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

PHOTOGRAPHS
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

PHOTOSYNTHESIS
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

PHYSIOLOGICAL ECOLOGY
BIOLOGY AND ECOLOGY OF NITROGEN.
W70-00277 02K

PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

PHYTOPLANKTON
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

PHYTOTOXICITY
PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
W70-00275 05C

PILE FOUNDATIONS
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

PILES(FOUNDATIONS)
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

PLANKTON
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

PLANNING
STATE PLANNING.
W70-00098 06E

INDIANA DRAINAGE CODE - DRAINAGE BOARDS - POWERS AND DUTIES.
W70-00131 06E

A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

PLANTS(NONLEGUMINOUS)
NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
W70-00280 02K

POINT BARS
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

POLICE POWERS
EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

POLLUTANT IDENTIFICATION
POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
W70-00093 05G

POLLUTION
LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
W70-00263 05B

POLLUTION ABATEMENT
POLLUTION CONTROL AMENDMENTS URGED.
W70-00086 05G

POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
W70-00093 05G

CHICAGO SANITARY DISTRICT.
W70-00172 05G

POROSITY
ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
W70-00248 02F

PORT AUTHORITIES
INTERSTATE PORT DISTRICT OF ILLINOIS AND INDIANA.
W70-00114 06E

INDIANA PORT COMMISSION.
W70-00116 06E

CHICAGO REGIONAL PORT COMMISSION.
W70-00192 04A

PORT AUTHORITIES.
W70-00194 04A

SENECA PORT DISTRICT.
W70-00393 04A

POWER PLANTS
INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
W70-00302 04B

BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
W70-00303 05C

PREFERENTIAL RIGHTS
PROSPECTING AND DEVELOPMENT OF RIVER BEDS, LAKE BEDS AND SHORE LANDS.
W70-00112 03E

PRESSURE CELLS
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

PRESSURE DISTRIBUTION
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

PRESSURE GAGES
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

PRESSURE MEASURING INSTRUMENTS
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

PRIMARY PRODUCTIVITY
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

PROBABILITY
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
W70-00041 04A

PRODUCTIVITY
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

PROJECT PLANNING
STATE PLANNING MISCELLANEOUS PROJECTS.
W70-00105 06E

A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

ENGINEER FOR LEVEE AND DRAINAGE DISTRICTS.
W70-00387 04A

SANITATION DISTRICTS.
W70-00401 05G

PROTECTIVE COATINGS
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

PUBLIC BENEFITS
EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

PRIVATE UNDERTAKINGS AS PUBLIC USES,
W70-00073 06E

CONDEMNATION FOR PUBLIC PROGRAMS,
W70-00075 06E

MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
W70-00187 06E

WATERS AND WATERCOURSES - FISHING - RIGHT OF PUBLIC IN FLOATABLE STREAMS.
W70-00315 06E

WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.
W70-00345 06E

PUBLIC EASEMENTS
WATERS AND WATERCOURSES - PUBLIC RIGHT OF FISHERY AS AN INCIDENT OF NAVIGATION.
W70-00345 06E

PUBLIC HEALTH
COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
W70-00308 05F

PUBLIC RIGHTS
THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
W70-00071 06E

THE SERVITUDE DOCTRINE THE DOCTRINE UNDER ENGLISH LAW,
W70-00081 06E

THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.
W70-00089 04A

MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
W70-00187 06E

PUBLIC USE
DAMS AND OBSTRUCTIONS - PROTECTION OF FISH.
W70-00195 04A

PUBLIC UTILITIES
EMINENT DOMAIN.
W70-00329 06E

PUMP HEAD
REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
W70-00320 05D

PYRITE
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

PYROLYSIS
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

RADIATION
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

RADIOACTIVE TRACERS
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

RADIOACTIVE WASTES
INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
W70-00240 05B

RADIOACTIVITY TECHNIQUES
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

RADIOISOTOPES
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

RADIUM RADIOISOTOPES
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

RAILROADS
RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
W70-00388 04A

RAINFALL
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

RAINFALL-RUNOFF RELATIONSHIPS
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
W70-00057 04C

WATERSHED HYDRAULICS IN THE LABORATORY,
W70-00065 02A

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
W70-00307 02G

RANDOM SAMPLING
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

REAL PROPERTY
POWER TO ACQUIRE CONTROL AND DISPOSE OF PROPERTY.
W70-00364 06E

HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).
W70-00372 06E

REASONABLE USE
RIPARIAN RIGHTS - REASONABLE USE THEORY.
W70-00083 04A

A NEW METHOD OF IRRIGATION,
W70-00090 03F

ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).
W70-00169 04A

RIPARIAN RIGHTS IN GEORGIA,
W70-00183 04A

RECESSION CURVES
A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
W70-00353 02E

RECHARGE
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

RECREATION
ACCESS BY THE PUBLIC TO A PRIVATE BODY OF WATER FOR RECREATIONAL PURPOSES.
W70-00089 04A

RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

RECREATION FACILITIES
STATE PLANNING.
W70-00098 06E

REDUCTION(CHEMICAL)
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

REGIMEN
DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

REGULATION
FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

FISHING THROUGH ICE HOLES.
W70-00117 06E

FISH LADDERS - REGULATIONS.
W70-00118 06E

MUSSELS - REGULATIONS.
W70-00119 06E

OPEN SEASON AND BAG LIMITS.
W70-00120 06E

FISH AND WILDLIFE RESOURCES.
W70-00199 03E

FERRIES ON STREAMS WITHIN STATE.
W70-00352 06E

FISH AND GAME (LICENSES).
W70-00370 06E

COMMERCIAL FISHING AND MUSSEL LICENSES.
W70-00378 06E

FISH AND GAME.
W70-00385 06E

REINFORCED CONCRETE
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
W70-00328 08F

REMEDIES
UNITED STATES V MORAN TOWING AND TRANSP CO (LIABILITY FOR OBSTRUCTION OF NAVIGABLE WATERS).
W70-00096 06E

HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
W70-00102 06E

FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
W70-00342 06E

REPULSION(LEGAL ASPECTS)
ARMSTRONG V FRANCIS CORPORATION (REPULSION OF SURPLUS WATER).
W70-00169 04A

RESERVOIR LEAKAGE
A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

RESERVOIR OPERATION
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
W70-00041 04A

A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

RESERVOIRS
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
W70-00293 05C

A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

JOINT CONSTRUCTION OF WATER SUPPLY.
W70-00371 03D

POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.
W70-00384 06E

RESOURCE DEVELOPMENT
FISH AND WILDLIFE RESOURCES.
W70-00106 06E

RESOURCES
WABASH VALLEY COMPACT.
W70-00193 04D

RETARDANCE
FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

REVETMENTS
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

REVIEWS
REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

RHEOLOGY
THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
W70-00018 02C

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

RHIZOBIUM
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

RIGHT-OF-WAY
MISSISSIPPI RIVER PARKWAY.
W70-00100 06E

RIPARIAN LAND
MCCUE V CARLTON (TITLE TO ACCRETIONS).
W70-00061 06E

RIPARIAN RIGHTS
MUNICIPAL WATER SUPPLIES,
W70-00074 06E

THE 'POSSIBILITY OF COMBINATION' RULE EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
W70-00078 06E

RIPARIAN RIGHTS - REASONABLE USE THEORY.
W70-00083 04A

WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.
W70-00091 04C

HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
W70-00102 06E

WATER LEVEL STABILIZATION.
W70-00126 04A

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
W70-00167 05G

TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

EXTENT OF PRIVATE RIGHTS IN NONNAVIGABLE LAKES,
W70-00182 04A

RIPARIAN RIGHTS IN GEORGIA,
W70-00183 04A

WATER LEGISLATION,
W70-00185 06D

MILLS AND MILL DAMS.
W70-00245 04A

HAYWARD V NOEL (ACTION FOR TRESPASS TO RIPARIAN LAND).
W70-00372 06E

RIPPLE MARKS
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
W70-00252 02J

RISKS
A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

RIVER FORECASTING
A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
W70-00353 02E

RIVER IMPROVEMENTS
RIVER IMPROVEMENTS BY THE UNITED STATES.
W70-00134 06E

RIVER VALLEY COMMISSIONS
OHIO RIVER VALLEY WATER SANITATION COMPACT.
W70-00391 05G

RIVERS
ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.
W70-00304 03D

A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
W70-00353 02E

STREAMS AND WATERS.
W70-00381 05G

ROCK FOUNDATIONS
PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

ROCK MECHANICS
STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
W70-00249 02F

PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

FAILURE OF FRACTURED ROCK,
W70-00350 08E

DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

ROCK PROPERTIES
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

ROCK RIVER(ILL)
ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS.
W70-00004 04A

ROCK TESTS
DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

ROCKS
PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

ROUGHNESS(HYDRAULIC)
FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

ROUTING
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

RUNOFF FORECASTING
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

THE MECHANICS OF SURFACE RUNOFF,
W70-00055 02E

THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

RUPTURING
FAILURE OF FRACTURED ROCK,
W70-00350 08E

SALINE LAKES
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

SALINE SOILS
DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

SALINE WATER
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

SALINE WATER INTRUSION
SALTWATER INTRUSION IN THE UNITED STATES.
W70-00211 02F

OIL, GAS, AND SALT WATER WELLS.
W70-00394 05G

SALINE WATER SYSTEMS
DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

SAMPLING
SEDIMENT MEASUREMENT TECHNIQUES A. FLUVIAL SEDIMENT,
W70-00214 02J

SEDIMENT MEASUREMENT TECHNIQUES F. LABORATORY PROCEDURES,
W70-00215 02J

EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

SAND WAVES
ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
W70-00252 02J

SANDS
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

SANITARY DISTRICTS
CHICAGO SANITARY DISTRICT.
W70-00171 05G

W70-00172 05G

SCHEDULING
A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

SCHLIEREN PHOTOGRAPHS
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

SEA OF AZOV
THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

SEA WATER
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

SEALANTS
A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

SEASHORES
THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

SEDIMENT CONTROL
AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

SEDIMENT CONTROL OPTIMIZATION
AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

SEDIMENT DISCHARGE
THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

SEDIMENT LOAD.
SEDIMENT MEASUREMENT TECHNIQUES A. FLUVIAL SEDIMENT,
W70-00214 02J

SEDIMENT RATING CURVES
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

SEDIMENT SAMPLERS
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

SEDIMENT TRANSPORT
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

SEDIMENTARY BASINS(GEOLOGICAL)
CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

SEDIMENTARY ROCKS
ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
W70-00248 02F

SEDIMENTARY STRUCTURES
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
W70-00252 02J

SEDIMENTATION
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

SEDIMENTATION RATES
CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

SEDIMENTS
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

SEDIMENT MEASUREMENT TECHNIQUES F. LABORATORY PROCEDURES,
W70-00215 02J

THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

SEDIMENT-WATER RELATIONSHIP
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

SEISMIC STUDIES
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

SEISMOLOGY
THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
W70-00333 08E

SELF PURIFICATION
COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

SELF-PURIFICATION
THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
W70-00148 05C

SERVITUDES
SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

SETTLEMENT
TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
W70-00302 04B

SETTLING VELOCITY
A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

SEWAGE
SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00113 06E

CHICAGO SANITARY DISTRICT.
W70-00173 05G

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
W70-00397 05G

SEWAGE BACTERIA
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

SEWAGE DISPOSAL
SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00113 06E

CHICAGO SANITARY DISTRICT.
W70-00172 05G

W70-00173 05G

SEWAGE DISPOSAL PLANTS
POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
W70-00093 05G

SEWAGE DISTRICTS
SANITATION DISTRICTS.
W70-00399 05G

W70-00400 05G

W70-00401 05G

W70-00402 05G

SEWAGE TREATMENT
CHICAGO SANITARY DISTRICT.
W70-00171 05G

W70-00172 05G

SEWERAGE
POLLUTION OF STREAMS--SEWAGE DISPOSAL PLANTS.
W70-00093 05G

SEWERS
SEWERS AND DRAINS IN CITIES AND TOWNS.
W70-00190 04C

ORGANIZATION AND GOVERNMENT OF CITIES-THIRD CLASS.
W70-00304 03D

SHALLOW WATER
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

SHEAR RESISTANCE
THE SLIDING STABILITY OF DAMS,
W70-00347 08A

SHEAR STRENGTH
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
W70-00328 08F

SHEAR TESTS
THE SLIDING STABILITY OF DAMS,
W70-00347 08A

SHELLFISH
FISH AND GAME (MUSSELS)
W70-00236 06E

SHERMAN GLACIER(ALASKA)
THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

SHOOT-ROOT TURNOVER
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,

W70-00284 02K

SHORES
POWER TO ACQUIRE CONTROL AND DISPOSE OF PROPERTY.
W70-00364 06E

RAILWAY CROSSINGS NEAR MISSISSIPPI RIVER.
W70-00388 04A

SIERRA NEVADA(CALIFORNIA)
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

SILTING
AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
W70-00250 02J

SIMULATION ANALYSIS
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

SINKHOLES
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

SLIDING RESISTANCE
THE SLIDING STABILITY OF DAMS,
W70-00347 08A

SLOPE PROTECTION
DRAINS AND LEVEES AFFECTING HIGHWAYS.
W70-00011 04C

SLOPE STABILITY
MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

SNOWFALL
RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

SOCIAL ACCOUNTING SYSTEM
ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
W70-00414 06B

SOIL CHEMISTRY
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

SOIL CONSERVATION
SOIL AND WATER CONSERVATION COMMISSION.
W70-00404 04A

SOIL CONSERVATION DISTRICTS
HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
W70-00102 06E

SOIL EROSION
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

SOIL FERTILITY
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

SOIL STRUCTURE
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

SOIL WATER MOVEMENT
CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

SOILS
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

SOILS(TROPICAL)
IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

SOLAR RADIATION
THERMAL STRATIFICATION IN LAKES ANALYTICAL AND LABORATORY,
W70-00141 02H

SOLUTES
INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

SOUTH CAROLINA
HIGHWAYS, BRIDGES, AND FERRIES-PROVISIONS FOR PARTICULAR COUNTIES.
W70-00094 06E

POWER OR WATER COMPANIES FLOODING BURIAL GROUNDS.
W70-00384 06E

PLANS OF RECLAMATION.
W70-00396 04A

SOUTH CHINA SEA
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

SOUTH DAKOTA
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

SOUTHEAST U
WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
W70-00085 06D

SOVEREIGN IMMUNITY
FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
W70-00342 06E

SOVIET CENTRAL ASIA
CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

SPECTROPHOTOMETRY
SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

SPITSBERGEN
SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
W70-00028 02C

SPORT FISH
SPORT FISHING.
W70-00409 06E

W70-00410 06E

W70-00411 06E

SPORT FISHING
FISH AND GAME (FISHING REGULATIONS).
W70-00212 06E

SPRINGS
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

SPRINKLER IRRIGATION
A NEW METHOD OF IRRIGATION,
W70-00090 03F

ST LAWRENCE RIVER
TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
W70-00180 04A

STANDARDS
NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
W70-00397 05G

STATE FORESTS
ARKANSAS FORESTRY COMMISSION.
W70-00407 04D

STATE GOVERNMENTS
FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
W70-00342 06E

STATE JURISDICTION
THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

STATISTICAL MODELS
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

STEEL LININGS
STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

STESS-STRAIN CURVES
FAILURE OF FRACTURED ROCK,
W70-00350 08E

STORM RUNOFF

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

STORM STRUCTURE
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

STRAINS
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

STRATIFICATION
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
W70-00293 05C

STRATIGRAPHY
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

STRAY CURRENT CORROSION
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

STREAM IMPROVEMENT
WATERCOURSES - CANALS - TOLL BRIDGES.
W70-00122 06E

STREAM TEMPERATURE
COMBINED CONDENSER COOLING SYSTEM UPS PLANT AVAILABILITY,
W70-00300 05G

STREAMFLOW
WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.
W70-00091 04C

IOWA NATURAL RESOURCES COUNCIL V MAPES (INJUNCTIVE ABATEMENT OF AN UNAUTHORIZED STREAM OBSTRUCTION).
W70-00097 06E

STREAMFLOW FORECASTING
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
W70-00041 04A

A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

STREAMS
NAVIGABLE WATERWAYS.
W70-00191 04A

OBSERVED LARGE-SCALE STRUCTURE OF TURBULENCE IN A RIVER MOUTH,
W70-00253 02L

PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

AMMONIA NITROGEN LOSSES FROM STREAMS,
W70-00267 05G

STREAMS AND WATERS.
W70-00381 05G

STRESS
DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
W70-00018 02C

STRIP MINE WASTES
STRIP MINING.
W70-00177 05G

STRIP MINES
STRIP MINING.
W70-00177 05G

STRIPED BASS
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

STRUCTURAL ANALYSIS
PHILOSOPHY OF FAILURE,
W70-00294 08A

MATHEMATICAL ASPECTS,
W70-00295 08A

STRUCTURAL BEHAVIOR
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

STRUCTURAL DESIGN
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

STRUCTURAL DESIGN PHILOSOPHY,
W70-00144 08A

CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

SUBSURFACE DRAINAGE
OIL AND GAS WELLS--DECLARATION OF POLICY.
W70-00386 05G

SUBSURFACE RUNOFF
NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

SUPERCRITICAL FLOW
DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

SURFACE DRAINAGE
DRAINAGE IMPROVEMENT DISTRICTS REMOVAL OF STREAM OBSTRUCTIONS.
W70-00225 04A

SURFACE RUNOFF
HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
W70-00137 02E

SURFACE SEALING
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

SURFACE WATERS
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.
W70-00087 04D

CONSERVATION DEPARTMENT.
W70-00136 06E

OIL AND GAS WELLS--DECLARATION OF POLICY.
W70-00386 05G

SURFACE-GROUNDWATER RELATIONSHIPS
ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

SURGES
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00009 02C

ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

INITIATION OF GLACIER SURGES,
W70-00015 02C

WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

WHAT ARE GLACIER SURGES,
W70-00022 02C

CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
W70-00028 02C

GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

PROPAGATION OF GLACIER SURGES,
W70-00033 02C

A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
W70-00221 02C

GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),
W70-00222 02C

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

SURGING GLACIERS
WHAT ARE GLACIER SURGES,
W70-00022 02C

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

SURVEILLANCE
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

SURVEYS
RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

STUDY OF WATER RESOURCES AND MANAGEMENT.
W70-00128 06B

RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

SUSPENDED LOAD
INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

SUSPENSION
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

SWITZERLAND
EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

SYMBIONTS
NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
W70-00280 02K

INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

SYMBIOTIC SPECIFICITY
PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

SYNTHETIC HYDROLOGY
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

THE MECHANICS OF SURFACE RUNOFF,
W70-00055 02E

ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
W70-00226 02E

GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

SYNTHETIC TEST METHODS
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

SYSTEM ANALYSIS
A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
W70-00306 10

TANNERY WASTES
ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A PILOT STUDY OF TREATING COMBINED CHROME TANNERY WASTES AND DOMESTIC SEWAGE.
W70-00163 05D

TELEMETRY
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

TEMPERATURE EFFECTS
EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
W70-00152 08B

TENNESSEE
INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
W70-00240 05B

TENNESSEE RIVER
TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.
W70-00178 05G

TEST FACILITIES
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

TEST PROCEDURES
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

THERMAL POLLUTION
USUAL APPLICATIONS OF COOLING TOWERS,
W70-00157 05D

INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
W70-00303 05C

THERMAL POWER PLANTS
OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS,
W70-00160 05F

THERMAL STRATIFICATION
THERMAL STRATIFICATION IN LAKES ANALYTICAL AND LABORATORY,
W70-00141 02H

CIRCULATION AND THERMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

THERMODYNAMICS
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

THUNDERSTORMS
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

TIDAL EFFECTS
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

TIDAL PHENOMENA
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

TIDAL WATERS
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

TIDES
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

TIDEWATER
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
W70-00159 05D

TILE DRAINAGE
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

TILE DRAINS
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

TILE SPACING

EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

TOTAL DISSOLVED SOLIDS
COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
W70-00308 05F

TOXICITY
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

TRACERS
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

TRANSMISSION LINES
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

TRANSMISSION TOWERS
SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

TRANSPORTATION
FERRIES ON STREAMS BORDERING STATE.
W70-00110 06E

FERRIES ON STREAMS WITHIN STATE.
W70-00352 06E

TRAVEL TIME
FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

TREATIES
TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
W70-00180 04A

TRIAXIAL COMPRESSION
FAILURE OF FRACTURED ROCK,
W70-00350 08E

TRITIUM
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

TROPICAL REGIONS
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

TUNNEL CONSTRUCTION
COUNTY BRIDGE CONSTRUCTION.
W70-00108 06E

STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
W70-00356 08A

TUNNEL LININGS
STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
W70-00356 08A

TUNNEL SUPPORTS
APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
W70-00356 08A

TURBIDITY CURRENTS
THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

TURBULENCE
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN),
W70-00147 05C

SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),
W70-00151 05G

OBSERVED LARGE-SCALE STRUCTURE OF TURBULENCE IN A RIVER MOUTH,
W70-00253 02L

PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW,
W70-00318 08B

UNIT HYDROGRAPH
HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
W70-00137 02E

UNIT HYDROGRAPHS
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

UNITED STATES
PROBLEMS OF VALUATION AND THE MILLER RULE,
W70-00077 06E

RIVER IMPROVEMENTS BY THE UNITED STATES.
W70-00134 06E

UNSATURATED FLOW
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
W70-00307 02G

UNSTEADY FLOW
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

URANIUM RADIOISOTOPES
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

URBANIZATION
SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
W70-00057 04C

USSR
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

UTAH
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

UTILITIES
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
W70-00162 05E

VEGETATION EFFECTS
FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

VERMONT
WATER POLLUTION CONTROL.
W70-00168 05G

VIBRATIONS
VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

VIEWERS
FENCES ON OVERFLOWED LANDS.
W70-00369 06E

VIRGINIA
BOERNER V MCCALLISTER (NAVIGABLE STREAMS).
W70-00099 06E

PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
W70-00167 05G

VISCOSITY
EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
W70-00152 08B

WASHINGTON
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

WASTE ASSIMILATIVE CAPACITY
COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

WASTE DILUTION
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),

W70-00151 05G

WASTE DISPOSAL
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
W70-00162 05E

WASTE TREATMENT
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A PILOT STUDY OF TREATING COMBINED CHROME TANNERY WASTES AND DOMESTIC SEWAGE.
W70-00163 05D

WASTE WATER(POLLUTION)
CHICAGO SANITARY DISTRICT.
W70-00174 05G

WATER ALLOCATION(POLICY)
WATER RIGHTS.
W70-00198 04C

WATER BALANCE
SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
W70-00057 04C

WATER CHEMISTRY
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

WATER CIRCULATION
WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

WATER CONSERVATION
RESERVOIR SITES FOR STORAGE OF WATER.
W70-00130 06E

DUTIES OF THE DEPARTMENT OF CONSERVATION.
W70-00135 05G

CONSERVATION DEPARTMENT.
W70-00136 06E

DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
W70-00395 04A

SOIL AND WATER CONSERVATION COMMISSION.
W70-00404 04A

WATER CONTROL
CHICAGO SANITARY DISTRICT.
W70-00175 05G

WATER DISTRICTS
DRAINS AND LEVEES-CONSERVANCY DISTRICTS.
W70-00395 04A

WATER FLOW
EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

WATER LAW
EMINENT DOMAIN AND WATER LAW,
W70-00070 06E

WATER RIGHTS AND OUR EXPANDING ECONOMY,
W70-00088 06D

WATER LEGISLATION,
W70-00185 06D

WATER LEVEL
WATER LEVEL PROTECTION.
W70-00125 04A

WATER LEVEL FLUCTUATIONS
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

WATER LEVELS
PROTECTION OF LAKES.
W70-00123 04A

WATER LEVEL PROTECTION.
W70-00124 04A

WATER LEVEL STABILIZATION.
W70-00126 04A

WATER LEVEL PROTECTION (LAKES).
W70-00127 04A

WATER LOSS
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

WATER MANAGEMENT(APPLIED)
PROTECTION OF LAKES.
W70-00123 04A

WATER LEVEL PROTECTION.
W70-00124 04A

W70-00125 04A

WATER LEVEL STABILIZATION.
W70-00126 04A

RESERVOIR SITES FOR STORAGE OF WATER.
W70-00130 06E

WATER PHYSICAL PROPERTIES
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

WATER POLICY
WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
W70-00085 06D

UTILITIES AND INDUSTRIES CORP V STATE (EMINENT DOMAIN).
W70-00238 06E

SOIL AND WATER CONSERVATION DISTRICTS LAW.
W70-00403 03D

WATER POLLUTION
PANTHER COAL CO V LOONEY (MINE WATER POLLUTION).
W70-00167 05G

WATER POLLUTION CONTROL.
W70-00168 05G

CHICAGO SANITARY DISTRICT.
W70-00171 05G

TENNESSEE RIVER BASIN WATER POLLUTION CONTROL COMPACT.
W70-00178 05G

TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

OHIO RIVER AREA COORDINATING COMMISSION.
W70-00196 06B

RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

WATER POLLUTION CONTROL
CONTROL OF MINE DRAINAGE WATER,
W70-00069 05G

POLLUTION CONTROL AMENDMENTS URGED.
W70-00086 05G

INTERSTATE WATER SANITATION BOARD.
W70-00107 05G

DUTIES OF THE DEPARTMENT OF CONSERVATION.
W70-00135 05G

WATER POLLUTION CONTROL.
W70-00168 05G

THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

OIL AND GAS WELLS--DECLARATION OF POLICY.
W70-00386 05G

OHIO RIVER VALLEY WATER SANITATION COMPACT.
W70-00391 05G

NORTH SUBURBAN SANITARY SEWER DISTRICT V WATER POLLUTION CONTROL COMM'N (WATER POLLUTION CONTROL STANDARDS).
W70-00397 05G

SANITATION DISTRICTS.
W70-00400 05G

WATER POLLUTION EFFECTS
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

WATER POLLUTION SOURCES
THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
W70-00062 05C

WATER PROPERTIES
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

WATER QUALITY
COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
W70-00067 02L

CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
W70-00308 05F

CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
W70-00313 06B

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

WATER QUALITY BENEFITS
CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
W70-00313 06B

WATER QUALITY CONTROL
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

WATER RATES
CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
W70-00382 05E

WATER RESOURCE DEVELOPMENT
SOIL AND WATER CONSERVATION DISTRICTS LAW.
W70-00403 03D

WATER RESOURCES
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

STUDY OF WATER RESOURCES AND MANAGEMENT.
W70-00128 06B

THE GROUNDWATER SITUATION IN OHIO,
W70-00203 02F

GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

THE WATER RESOURCE,
W70-00272 06G

A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
W70-00306 10

SOIL AND WATER CONSERVATION DISTRICTS LAW.
W70-00403 03D

WATER RESOURCES DEVELOPMENT
WATER RIGHTS AND OUR EXPANDING ECONOMY,
W70-00088 06D

STATE PLANNING MISCELLANEOUS PROJECTS.
W70-00105 06E

A STATE STATUTE TO POVIDE CONTROLS FOR EQUITABLE DISTRIBUTION OF WATER.
W70-00184 06D

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

ADMINISTRATIVE ASPECTS (OF WATER), (IN DUTCH),
W70-00297 06D

OHIO VALLEY COMPACT.
W70-00380 06B

WATER RIGHTS
WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
W70-00085 06D

WATER RIGHTS AND OUR EXPANDING ECONOMY,
W70-00088 06D

STUDY OF WATER RESOURCES AND MANAGEMENT.
W70-00128 06B

WATER RIGHTS.
W70-00198 04C

WATER SANITATION
INTERSTATE WATER SANITATION BOARD.
W70-00107 05G

WATER STORAGE
ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
W70-00041 04A

RESERVOIR SITES FOR STORAGE OF WATER.
W70-00130 06E

GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

WATER STRUCTURE
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

WATER SUPPLY
SUNHILL WATER CORP V WATER RESOURCES COMM'N (REVIEW OF WATER RESOURCES COMMISSION GRANT TO SUPPLY WATER).
W70-00103 06E

LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
W70-00263 05B

JOINT OPERATION OF WATER SOURCES.
W70-00276 03D

RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

JOINT CONSTRUCTION OF WATER SUPPLY.
W70-00371 03D

WATER TEMPERATURE
EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
W70-00152 08B

WATER TREATMENT
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
W70-00162 05E

WATER USERS
WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
W70-00085 06D

WATER RIGHTS.
W70-00198 04C

WATER UTILIZATION
PRIVATE UNDERTAKINGS AS PUBLIC USES,
W70-00073 06E

WATER RIGHTS AND OUR EXPANDING ECONOMY,
W70-00088 06D

WATERS--RIPARIAN RIGHTS--PROPERTY IN FLOW OF STREAM.
W70-00091 04C

WATER LEGISLATION,
W70-00185 06D

PROBLEMS OF THE PROTECTION OF WATER IN CONNECTION WITH THE BUILDING OF WATER-POWER PLANTS (IN GERMAN),
W70-00292 05G

WATER WELLS
WATER WELL DRILLERS.
W70-00179 04B

WATER WORKS
JOINT CONSTRUCTION OF WATER SUPPLY.
W70-00371 03D

WATER YIELD IMPROVEMENT
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

WATERCOURSES(LEGAL)
BRIDGES, CULVERTS, SEWERS AND WATERCOURSES IN SECOND CLASS CITIES.
W70-00301 06E

WATERSHED MANAGEMENT
OUTLINE OF ARKANSAS PLAN ON WATERSHED MANAGEMENT.
W70-00087 04D

WATERSHED CONSERVANCY DISTRICTS.
W70-00368 04D

WATERSHED MODELS
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

WATERSHED STUDIES
HIDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
W70-00137 02E

WATERSHEDS
WATERSHED CONSERVANCY DISTRICTS.
W70-00368 04D

WATERWORKS
CITY OF MARYVILLE V CUSHMAN (RIGHT TO CHARGE FOR SEWAGE DISPOSAL).
W70-00382 05E

WATER-LOSS
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

WAVES(NONCOHESIVE MEDIA)
ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
W70-00252 02J

WAVES(WATER)
A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,

W70-00003 08B

THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
W70-00218 08B

DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

WEATHER MODIFICATION
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS.
W70-00140 06G

DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

WELL REGULATIONS
OIL, GAS, AND SALT WATER WELLS.
W70-00394 05G

WELLS
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

OIL, GAS, AND SALT WATER WELLS.
W70-00394 05G

WEST SPITSBERGEN
GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

WEST VIRGINIA
HESSE V STATE CONSERVATION COMM (IMMUNITY FROM SUITS AGAINST STATE AGENCIES AND SOIL CONSERVATION DISTRICTS).
W70-00102 06E

FIRESTONE TIRE AND RUBBER CO V RITCHIE (CONDEMNATION PROCEEDINGS AGAINST PERSONALTY NOT AUTHORIZED).
W70-00342 06E

WHITE SEA
INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

WILDLIFE CONSERVATION
FISH AND WILDLIFE RESOURCES.
W70-00106 06E

MUSSELS - REGULATIONS.
W70-00119 06E

OPEN SEASON AND BAG LIMITS.
W70-00120 06E

STATE COOPERATION IN FEDERAL WILDLIFE CONSERVATION PROJECTS.
W70-00121 06E

DUTIES OF THE DEPARTMENT OF CONSERVATION.
W70-00135 05G

W R WRAPE STAVE CO V ARKANSAS STATE GAME AND FISH COMM'N (CONDEMNATION FOR CONSERVATION OF WILDLIFE).
W70-00379 06G

WILDLIFE RESOURCES
FISH AND WILDLIFE RESOURCES.
W70-00106 06E

WIND PRESSURE
STRUCTURAL DESIGN PHILOSOPHY,
W70-00144 08A

VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

SOME AERODYNAMIC PROBLEMS OF GROUPED COOLING TOWERS,
W70-00298 08A

WINDS
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

WINTER
WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

WISCONSIN
FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN.
W70-00008 04A

MUENCH V PUBLIC SERVICE COMMISSION (DELEGATION OF LEGISLATIVE POWER OVER MATTERS OF STATE-WIDE INTEREST).
W70-00187 06E

YELLOWSTONE PARK(WYO)
RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

YUKON TERRITORY
OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00069 02C

AUTHOR INDEX

AGNOR, WILLIAM H.
RIPARIAN RIGHTS IN GEORGIA,
W70-00183 04A

AITSAM, A. M.
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
W70-00148 05C

COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

ALBASINY, E. L.
MATHEMATICAL ASPECTS,
W70-00295 08A

ALEXANDER, MARTIN
PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS,
W70-00290 02K

ALLEN, SEWARD E.
PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
W70-00275 05C

ALLMAN, DAVID W.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

ALVERSON, DAYTON L.
RECENT DEVELOPMENTS IN FISHING METHODS AND EFFECTS OF MANAGEMENT ON EFFICIENCY,
W70-00413 06B

ANDERSON, DAVID W.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

ANDERSON, FRED A.
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

AXTMAN, ROBERT C.
QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
W70-00046 08G

BAARS, J. K.
BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
W70-00303 05C

BAINES, W. DOUGLAS
PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW,
W70-00318 08B

BAINES, W. D.
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

BAKER, A. L. L.
PHILOSOPHY OF FAILURE,
W70-00294 08A

BAKKER, W. T.
A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
W70-00043 02J

BALDWIN, A. DWIGHT, JR.
GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
W70-00067 02L

BALLINGER, DWIGHT G.
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

BALLOFFET, ARMANDO
ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS,
W70-00226 02E

BARANOVA, D. D.
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

BARDET, J.
TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH),
W70-00302 04B

BARNES, P.
PROPAGATION OF GLACIER SURGES,
W70-00033 02C

BARON, V. A.
CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

BAUMAN, E. ROBERT
MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

BENEDICT, PAUL C.
SEDIMENT MEASUREMENT TECHNIQUES A. FLUVIAL SEDIMENT,
W70-00214 02J

BICKING, CHARLES A.
OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

BIENIAWSKI, Z. T.
FAILURE OF FRACTURED ROCK,
W70-00350 08E

BLIGHT, GEOFFREY E.
FOUNDATION FAILURES OF FOUR ROCKFILL SLOPES,
W70-00363 08D

BOHNER, G. E., JR.
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

BOOIJ, C. G.
INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

BOUGHTON, W. C.
GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

BREMNER, J. M.
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

BRESLER, E.
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

BROCK, RICHARD R.
DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

BROMS, BENGT B.
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS,
W70-00328 08F

BROOKS, R. R.
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

BRUCE, JOHN
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
W70-00159 05D

BUCHLI, GARY L.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

BULL, COLIN
THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

BUNKER, ROBERT M.
CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

BURHOUSE, P.
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS,
W70-00339 08A

BUSBY, C. E.
WATER RIGHTS AND OUR EXPANDING ECONOMY,
W70-00088 06D

CADY, P. D.
MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

CALDWELL, LOREN T.
GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

CARREKER, JOHN R.
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

CARRIGAN, P. H., JR.
INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,

W70-00240 05B

CARSWELL, J. KEITH
RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

CARTWRIGHT, KEROS
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

CASPERS, HUBERT
CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES,
W70-00268 05C

CHADWICK, PHILIP
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

CHENG, K. L.
SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

CHEN, CHENG-LUNG
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

CHIDLEY, T. R. E.
A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
W70-00353 02E

CHILVER, A. H.
STRUCTURAL DESIGN PHILOSOPHY,
W70-00144 08A

CHRISTIE, D. G.
REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
W70-00320 05D

CHU, SHU-TUNG
HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
W70-00137 02E

CHU, YEN-HSI
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

CLENDENNING, T. G.
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

COBURN, M. M.
SYSTEMS APPROACH TO ORGANIC COATINGS,
W70-00358 08G

COLBY, B. R.
EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
W70-00152 08B

COLTHARP, GEORGE B.
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

COOPER, CHARLES F.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS.
W70-00140 06G

COWLEY, JAMES E.
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

COX, ROBERT G.
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

CRUFF, R. W.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

CULLIS, J. W.
EXTENT OF PRIVATE RIGHTS IN NONNAVIGABLE LAKES,
W70-00182 04A

DAGAN, GEDEON
DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
W70-00210 08B

DAHLMAN, ROGER
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

DAKE, JONAS M. K.
THERMAL STRATIFICATION IN LAKES ANALYTICAL AND LABORATORY,
W70-00141 02H

DANIEL, DONNIE L.
A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

DAVIS, T. G.
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

DE TURVILLE, C. M.
THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
W70-00150 05C

DELWICHE, C. C.
THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

DENKHAUS, H. G.
FAILURE OF FRACTURED ROCK,
W70-00350 08E

DESAI, HARSHA
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

DI SILVIO, GIAMPAOLO
FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS,
W70-00218 08B

DICKEY, PARKE A.
CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA,
W70-00247 02J

DISKIN, M. H.
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE,
W70-00039 07B

DISKO, MICHAEL D.
DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
W70-00068 02L

DOBEREINER, JOHANNA
NONSYMBIOTIC NITROGEN FIXATION IN TROPICAL SOILS,
W70-00288 02K

DOUGAL, MERWIN D.
MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

DOXTADER, KENNETH
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

DUGDALE, R. C.
THE NITROGEN CYCLE IN THE SEA,
W70-00279 02K

DULBERG, SAMUEL S.
APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
W70-00356 08A

EDMONDSON, W. T.
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME,
W70-00270 05C

EISENBERG, D.
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

ELLIOTT, ROBERT D.
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

ERICKSON, L. E.
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

FAN, L. T.
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

FIALA, L.
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
W70-00293 05C

FIELD, WILLIAM O.
CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

FINENKO, Z. Z.
INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

FINNERTY, J. J.
USUAL APPLICATIONS OF COOLING TOWERS,
W70-00157 05D

FITZHERBERT, W. A.
CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

FLAHERTY, DAVID C.
DEATH OF A LAKE,
W70-00264 05C

FLORKOWSKI, T.
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

FORD, GORDON L.
COMBINED CONDENSER COOLING SYSTEM UPS PLANT AVAILABILITY,
W70-00300 05G

FRACZEK, EDWARD
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

FRANCO, JOHN J.
EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

FREIRE, J. R. JARDIM
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

FRENKLIKH, M. S.
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

GAMESON, A. L. H.
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
W70-00158 05C

GANNON, JOHN J.
COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

GARDNER, GEORGE R.
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

GARN, HARVEY A.
ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
W70-00414 06B

GARRISON, ROBERT L.
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

GATES, MARVIN
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

GEORGI, CARL E.
BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
W70-00139 03A

GERSTEIN, HYMAN H.
LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY,
W70-00263 05B

GIDLUND, ERICK E.
DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES,
W70-00068 02L

GLANCY, P. A.
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

GOEPFERT, CARLOS F.
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

GORHAM, P. R.
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

GRANT, P. J.
VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

GRIES, JOHN PAUL
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA,
W70-00310 02G

GROSSLING, B. F.
COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

GULINCK, M.
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT MOUSCRON, BELGIUM (FRENCH),
W70-00040 02F

GUY, HAROLD P.
SEDIMENT MEASUREMENT TECHNIQUES F. LABORATORY PROCEDURES,
W70-00215 02J

GYSI, MARSHALL
A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
W70-00306 10

HALL, H.
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
W70-00158 05C

HALL, JAMES B.
CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

HAMMER, U. T.
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

HAMMING, EDWARD
WATER LEGISLATION,
W70-00185 06D

HANNAH, I. W.
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

HANSEN, E. P.
STATUS OF BIG COOLING TOWERS,
W70-00321 08A

HARBAUGH, TERENCE E.
WATERSHED HYDRAULICS IN THE LABORATORY,
W70-00065 02A

HARIGUILLIE, M.
AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
W70-00250 02J

HARLEMAN, DONALD R. F.
THERMAL STRATIFICATION IN LAKES ANALYTICAL AND LABORATORY,
W70-00141 02H

CIRCULATION AND THEMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

HARNSBERGER, RICHARD S.
EMINENT DOMAIN AND WATER LAW,
W70-00070 06E

THE NATURE AND SCOPE OF THE EMINENT DOMAIN POWER,
W70-00071 06E

EMINENT DOMAIN AND POLICE POWER,
W70-00072 06E

PRIVATE UNDERTAKINGS AS PUBLIC USES,
W70-00073 06E

MUNICIPAL WATER SUPPLIES,
W70-00074 06E

CONDEMNATION FOR PUBLIC PROGRAMS,
W70-00075 06E

THE 'RIVER' CASES,
W70-00076 06E

PROBLEMS OF VALUATION AND THE MILLER RULE,
W70-00077 06E

THE 'POSSIBILITY OF COMBINATION' RULE EFFECT OF FEDERAL WATER POWER ACT ON PRIVATE RIGHTS,
W70-00078 06E

NON-COMPENSABILITY OF LOCATIONAL VALUES ATTRIBUTABLE TO USE OF THE FLOW,
W70-00079 06E

SUMMARY OF SERVITUDE DECISIONS RELATING TO COMPENSABILITY,
W70-00080 06E

THE SERVITUDE DOCTRINE THE DOCTRINE UNDER ENGLISH LAW,
W70-00081 06E

THE COMMON LAW RIGHT OF THE PUBLIC TO NAVIGATE IN PRIVATE WATERS STATUS OF STATE CREATED RIGHTS,
W70-00082 06E

HARRISON, A. E.
GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA,
W70-00020 02C

HART, GEORGE E., JR.
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

HASE, E.
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

HATTERSLEY-SMITH, G.
RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND,
W70-00021 02C

HAUCK, R. D.
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES,
W70-00282 02K

HEWITT, KENNETH
GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA),

W70-00222 02C

HIBDON, JAMES E.
FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
W70-00416 06B

HICKIN, EDWARD J.
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS,
W70-00034 02J

HILL, HARRY M.
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

HILL, H. W.
CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
W70-00202 02L

HINGORANI, NARAIN G.
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

HITCHON, BRIAN
ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
W70-00248 02F

HOINKES, HERFRIED C.
SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

HOLLIN, JOHN T.
ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

HOOVER, J. R.
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

HORVATH, EVA V.
REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

HRBACEK, J.
CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA,
W70-00274 05C

HUNSUCKER, W. A.
OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS,
W70-00160 05F

IRWIN, GEORGE A.
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

IWAMURA, T.
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

JARMAN, R. T.
THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
W70-00150 05C

JASPAR, J. L.
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

JENKINS, C. T.
ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

JENKOVICH, V. P.
THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

JOERES, ERHARD F.
AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

JOHNSON, J. A.
WATER-USE AND WATER-RIGHTS POLICY IS CHANGING,
W70-00085 06D

JOLLY, WILLIAM C.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS.
W70-00140 06G

JONAS, JOHN J.
DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
W70-00018 02C

JONES, BRUCE E.
CONTROL OF MINE DRAINAGE WATER,
W70-00069 05G

JORGENSEN, D. G.
A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

JOYE, DONALD D.
QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
W70-00046 08G

KAPLAN, I. R.
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

KARAUSHEV, A. V.
SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),
W70-00151 05G

KAUZMANN, W.
THE STRUCTURE AND PROPERTIES OF WATER,
W70-00242 01A

KEFFER, J. F.
THE ROUND TURBULENT JET IN A CROSS WIND,
W70-00154 08A

KELLY, A. G.
ECONOMIC SIZING OF COOLING TOWERS,
W70-00155 05D

KHAYLOV, K. M.
INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

KHRUSTALEV, YU P.
THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

KIM, W. K.
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

KNAUSS, JAMES D.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

KOMAR, PAUL D.
THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL,
W70-00223 02L

KOUWEN, NICHOLAS
FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

KRIVONOSOVA, N. M.
INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

KUBA, EDWARD M.
A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
W70-00003 08B

KUZNETSOV, YU. A.
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

LABER, GENE
ALTERNATIVE USES OF THE NATURAL ENVIRONMENT,
W70-00414 06B

LAMBERTON, BRUCE A.
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

LARSEN, WILLIAM R.
GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

LATIF, ABDUL
INVESTIGATION OF BRAHMAPUTRA RIVER,
W70-00219 02E

LAWFORD, H. J.
TREATIES AND RIGHTS OF TRANSIT ON THE ST LAWRENCE,
W70-00180 04A

LAWLESS, M. R.
ECONOMIC SIZING OF COOLING TOWERS,
W70-00155 05D

LEBRAS, L. R.
SYSTEMS APPROACH TO ORGANIC COATINGS,
W70-00358 08G

LEE, E. S.
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

LEOPOLD, LUNA B.
THE WATER RESOURCE,
W70-00272 06G

LEPETIT, J. P.
AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH),
W70-00250 02J

LEROUX, E. F.
A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

LIESTOL, OLAV
GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

LIGGETT, JAMES A.
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

LINK, HARALD
THE SLIDING STABILITY OF DAMS,
W70-00347 08A

LISITSYN, A. P.
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

LITTLE, E. C. S.
THE CONTROL OF WATER WEEDS.
W70-00269 05G

LLIBOUTRY, LOUIS A.
A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH),
W70-00221 02C

LOCKMAN, WILLIAM
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND MORROW POINT DAMS,
W70-00335 08A

LOEHR, RAYMOND C.
THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
W70-00062 05C

LOKEN, O. H.
EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND,
W70-00032 02C

LONDE, PIERRE
PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

LONGENBAUGH, ROBERT A.
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM,
W70-00054 02A

LOOMIS, H. S.
INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

LOUCKS, DANIEL P.
A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS,
W70-00306 10

LOUIS, CLAUDE
STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH),
W70-00249 02F

LOVELL, HAROLD L.
CONTROL OF MINE DRAINAGE WATER,
W70-00069 05G

LOVE, O. TOM
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

LYTLE, WILLIAM F.
HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA,
W70-00137 02E

MAGARA, KINJI
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

MAJUMDAR, K. C.
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

MALIY, V. A.
NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

MARINER, L. T.
OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS,
W70-00160 05F

MARTIN, D. W.
MATHEMATICAL ASPECTS,
W70-00295 08A

MATTHEWS, T. R.
SYSTEMS APPROACH TO ORGANIC COATINGS,
W70-00358 08G

MCDERMOTT, JAMES H.
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

MCINTIRE, C. DAVID
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

MCKERCHAR, A.
GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

MCLACHLAN, J.
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

MCWHORTER, R. L.
A NEW METHOD OF IRRIGATION,
W70-00090 03F

MEDVEDEV, V. S.
INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

MEIER, MARK F.
SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

WHAT ARE GLACIER SURGES,
W70-00022 02C

MESSERLE, H. K.
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

MEYER, D. L.
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

MIRONICHEVA, G. V.
DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN),
W70-00237 03A

MOIR, LEO H., JR.
STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

MOKADY, R. S.
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW,
W70-00045 02K

MORRISON, W. R.
LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

MOULDER, E. A.
ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS,
W70-00204 02F

MULLER, FRITZ
DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,
W70-00018 02C

WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

MULLER, ROBERT A.
SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,
W70-00057 04C

NANNY, P.
PROBLEMS OF THE PROTECTION OF WATER IN CONNECTION WITH THE BUILDING OF WATER-POWER PLANTS (IN GERMAN),
W70-00292 05G

NEEL, JOE K.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

NEIL, FORREST C.
GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

NELSON, ROBERT Y.
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

NIELSEN, LAWRENCE E.
THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

NIEMCZYNOWICZ, JANUSZ
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

NIHEI, T.
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,

W70-00261 05C

NORRIS, STANLEY E.
THE GROUNDWATER SITUATION IN OHIO,
W70-00203 02F

OKADA, KAZUHIKO
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

OLSON, JERRY S.
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

OSBORN, H. B.
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

OSTLUND, H. GOTE
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

OWENS, MORLAIS
SOME ASPECTS OF THE EUTROPHICATION OF WATER,
W70-00266 05C

OWEN, P. R.
SOME AERODYNAMIC PROBLEMS OF GROUPED COOLING TOWERS,
W70-00298 08A

PAAL, L. L.
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN),
W70-00147 05C

THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
W70-00148 05C

COMPUTATION OF OXIGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

PAIN, C. F.
GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
W70-00254 02J

PAPADOPULOS, ISTAVROS S.
GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

PARKER, J. J.
STATUS OF BIG COOLING TOWERS,
W70-00321 08A

PATIN, PIERRE
A NEW METHOD OF DETECTING AND SEALING LEAKS IN WATER RESERVOIRS,
W70-00322 08E

PEABODY, A. W.
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES,
W70-00365 08C

PEARSON, F. H.
GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

PENGRA, R. M.
NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS,
W70-00280 02K

PETRUSHEVSKIY, B. A.
THE RIGHT APPROACH TO EARTHQUAKE PREDICTION,
W70-00333 08E

PHINNEY, HARRY K.
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

POLIKARPOV, G. G.
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

POST, AUSTIN
WHAT ARE GLACIER SURGES,
W70-00022 02C

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

PRABHAKAR, D. R. L.
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

PREDDY, W. S.
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II,
W70-00158 05C

PRESLEY, B. J.
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

PRETTE, BRUCE D.
PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW,
W70-00318 08B

RAGOTZKIE, ROBERT A.
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

RAMSTER, J. W.
CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
W70-00202 02L

RAPHAEL, DAVID L.
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

RAYMONT, J. E. G.
SEA PLANTS FOR FOOD,
W70-00161 03C

REID, GEORGE W.
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

RENARD, KENNETH G.
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

RENARD, K. G.
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

RICHARDSON, KEISTER L., JR.
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

RINKEL, MURICE O.
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

ROBECK, GORDON G.
RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

ROBERTS, WILLIAM M. B.
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

ROBINSON, K. E.
SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

ROBIN, G. DE Q.
INITIATION OF GLACIER SURGES,
W70-00015 02C

PROPAGATION OF GLACIER SURGES,
W70-00033 02C

RODEN, GUNNAR I.
WINTER CIRCULATION IN THE GULF OF ALASKA,
W70-00220 02L

ROOTH, CLAES
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

ROSS, B. E.
TORTS - NUISANCE INTERESTS WHICH WILL SUSTAIN A NUISANCE ACTION,
W70-00181 05G

ROTHLISBERGER, H.
EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS,
W70-00027 02C

ROUND, F. E.
THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
W70-00271 05C

ROUSE, GEORGE C.
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND MORROW POINT DAMS,
W70-00335 08A

ROWLAND, W. R.
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

RUSCK, SUNE
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

RUTTER, NATHANIEL W.
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS,
W70-00007 02C

SABARLY, FRANCIS
PERMEABILITY DISTRIBUTION IN ARCH DAM FOUNDATIONS AS A FUNCTION OF THE STRESS FIELD,
W70-00323 08E

SALOMON, WARREN M.

ACCRETION - A NEW SLANT,
W70-00170 04A

SARKAR, TARIT KUMAR
MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
W70-00307 02G

SAVEL'YEVA, R. V.
CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN),
W70-00243 03A

SAYERS, WILLIAM T.
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL,
W70-00305 05A

SCARPA, AMERIGO
EARTHWORK QUANTITIES BY RANDOM SAMPLING,
W70-00341 08D

SCHAAKE, JOHN C., JR.
THE MECHANICS OF SURFACE RUNOFF,
W70-00055 02E

SCHELLER, WM. A.
BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
W70-00139 03A

SCHUBEL, J. R.
SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

SCHULTZ, JOHN D.
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

SCHWAB, G. O.
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

SCHYTT, V.
SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD,
W70-00028 02C

SCOTT, C. H.
EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL,
W70-00152 08B

SCOTT, JOHN T.
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

SHAFFER, R. K.
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

SHARP, JAMES J.
SPREAD OF BUOYANT JETS AT THE FREE SURFACE,
W70-00232 08B

SHCHERBAKOV, F. A.
THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

SHERMAN, FRANK B.
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

SHIBATA, K.
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

SHICHIRI, YOSHIO
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

SHIELDS, RONALD R.
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

SHTENKO, V. W.
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

SHTEYNMAN, B. S.
OBSERVED LARGE-SCALE STRUCTURE OF TURBULENCE IN A RIVER MOUTH,
W70-00253 02L

SHULYAK, B. A.
ON THE NATURE OF THE PERIODICITY OF WAVES ON THE SURFACE OF A NONCOHESIVE MEDIUM (A CRITICAL REVIEW OF THE TURBULENCE HYPOTHESIS),
W70-00252 02J

SILVEY, WILLIAM D.
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

SIMONYAK, Z. N.
URANIUM AND RADIUM IN THE SURFACE LAYER OF OCEANIC SEDIMENTS,
W70-00044 02J

SKOOG, FOLKE
PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
W70-00275 05C

SKOPINTSEV, B. A.
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

SLADECEK, V.
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN),
W70-00293 05C

SLEBIR, EDWARD J.
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

SOPPER, WILLIAM E.
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY,
W70-00209 02F

SPANGENBERG, W. G.
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

SPENCER, R. W.
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER,
W70-00159 05D

SRINIVASAN, VAJAPEYAM S.
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

STANLEY, A. D.
OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA,
W70-00009 02C

STEIN, ROBERT D.
NAVIGATIONAL SERVITUDE AN OLD CONCEPT WITH A NEW LIMITATION,
W70-00084 04A

STEPHENS, JOHN C.
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

STERN, DANIEL H.
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

STERN, MICHELE S.
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

STERN, W. M.
HYPERBOLIC COOLING TOWERS,
W70-00291 08A

STEWART, P. D.
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

STRATTON, FRANK E.
AMMONIA NITROGEN LOSSES FROM STREAMS,
W70-00267 05G

STREEBIN, LEALE E.
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

STUBBS, JAMES A.
STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND NORROW POINT DAMS,
W70-00335 08A

STURHUP, V. H.
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

SWANSTON, DOUGLAS N.
MASS WASTING IN COASTAL ALASKA,
W70-00164 02J

SWANSTON, D. N.
A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA,
W70-00166 02C

SWEETING, D. K.
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES,
W70-00326 08C

SYMONS, JAMES M.
RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

TAMIYA, H.
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA,
W70-00261 05C

TAYLOR, H.

SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

THOMAS, ADRIAN W.
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

THOMAS, H. S. H.
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

THORARINSSON, SIGURDUR
GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

THUY, NGUYEN NGOC
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

TILSON, SEYMOUR
THE WATER RESOURCE,
W70-00272 06G

TSOUTRELIS, C. E.
DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

UNNY, THARAKKAL E., JR.
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS,
W70-00217 08B

UNNY, T. E.
FLOW RETARDANCE IN VEGETATED CHANNELS,
W70-00228 08B

VELNER, H. A.
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN),
W70-00146 05C

THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN),
W70-00148 05C

COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN),
W70-00149 05C

VENETIS, C.
ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT,
W70-00041 04A

VENNES, JOHN W.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

VIDOR, CAIO
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

VOGLER, U. W.
FAILURE OF FRACTURED ROCK,
W70-00350 08E

WALLACE, GEORGE B.
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

WALLANDER, B.
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

WALTERS, KENNETH L.
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

WANG, CHUN-TSUNG
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

WARD, W. H.
THE DESIGN, CONSTRUCTION AND PERFORMANCE OF A VIBRATING-WIRE EARTH PRESSURE CELL,
W70-00337 07B

WARREN, CHARLES E.
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

WEERTMAN, J.
WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

WERSHAW, R. L.
PYROLYSIS OF HUMIC AND FULVIC ACIDS,
W70-00241 02K

WEZERNAK, C. T.
COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

WHIPPLE, WILLIAM, JR.
CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS,
W70-00313 06B

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS,
W70-00314 05B

WHITE, DONALD E.
RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

WILD, L. O.
RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
W70-00316 05D

WILLIAMS, D. C., JR.
A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
W70-00213 06B

WILLIAMS, JIMMY R.
FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

WILLIAMS, J. J.
VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

WILLIAMS, ROY E.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

WILLIAMS, W. A.
EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

WILSON, A. T.
THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS,
W70-00014 02C

WILSON, H. A.
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

WINSEMIUS, J. P.
ADMINISTRATIVE ASPECTS (OF WATER), (IN DUTCH),
W70-00297 06D

WOOD, GAVIN
SOME ASPECTS OF THE EUTROPHICATION OF WATER,
W70-00266 05C

WOOD, I. R.
HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
W70-00319 08B

WOOD, SAMUEL E.
CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
W70-00415 03D

WOOLHISER, DAVID A.
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION,
W70-00056 02A

YAMASAKI, MATSUJIRO
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

YEVICH, PAUL P.
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES,
W70-00417 05C

YOUNG, L. E.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

YURKEVICH, M. G.
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

ZAN, MICHAEL
MANIPULATION OF WATER USE IN AN ASPEN FOREST,
W70-00058 03B

ZEMELMAN, RAUL
AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES,
W70-00286 02K

ZINKE, PAUL J.
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

ORGANIZATIONAL INDEX

ACRES (H. G.) AND CO. LTD., NIAGARA FALLS (ONTARIO).
TIDAL MODEL OF NORTHUMBERLAND STRAIT,
W70-00231 02L

AGRICULTURAL RESEARCH COUNCIL, KIDLINGTON (ENGLAND). WEED RESEARCH ORGANIZATION.
THE CONTROL OF WATER WEEDS.
W70-00269 05G

AGRICULTURAL RESEARCH SERVICE, ATHENS, GA. SOUTHEAST WATERSHED RESEARCH CENTER.
PEAT AND MUCK DRAINAGE PROBLEMS,
W70-00229 04A

AGRICULTURAL RESEARCH SERVICE, BUSHLAND, TEX.
FLOOD ROUTING WITH VARIABLE TRAVEL TIME OR VARIABLE STORAGE COEFFICIENTS,
W70-00344 02E

AGRICULTURAL RESEARCH SERVICE, TIFTON, GA. SOIL AND WATER CONSERVATION RESEARCH DIV. AND AGRICULTURAL RESEARCH SERVICE, ATHENS, GA. SOIL AND WATER CONSERVATION RESEARCH DIV.
PREDICTION OF SOIL AND WATER LOSSES,
W70-00066 02A

AGRICULTURAL RESEARCH SERVICE, TUCSON, ARIZ.
SEDIMENT RATING CURVES IN EPHEMERAL STREAMS,
W70-00343 02J

AGRICULTURAL RESEARCH SERVICE, TUCSON, ARIZ. SOUTHWEST WATERSHED RESEARCH CENTER.
ANALYSIS OF TWO MAJOR RUNOFF-PRODUCING SOUTHWEST THUNDERSTORMS,
W70-00037 02A

AKADEMIYA NAUK SSSR. INSTITUT OKEANOLOGII.
THE USE OF THE SAND-TRANSPORTING PROPERTIES OF WAVES IN LITTORAL DRIFT STUDY,
W70-00050 02J

THE NEAR-SHORE SHALLOWS OF WESTERN CUBA AND THEIR SEDIMENTS (RUSSIAN),
W70-00234 02L

INVESTIGATION OF QUANTITATIVE DISTRIBUTION OF SUSPENSION IN COASTAL WATERS OF THE WHITE SEA,
W70-00259 02L

AKADEMIYA NAUK URSR. INST. OF BIOLOGY OF THE SOUTHERN SEAS.
ADSORPTION AND DESORPTION OF RADIONUCLIDES BY SHALLOW-WATER SEDIMENTS OF THE BLACK SEA,
W70-00049 02J

INTERACTION OF DETRITUS WITH HIGH-MOLECULAR-WEIGHT COMPONENTS OF DISSOLVED ORGANIC MATTER IN SEA WATER,
W70-00258 02K

AKADEMIYA NAUK URSR. MARINE HYDROPHYSICS INST.
SOME REDUCTION AND OXIDATION PROCESSES IN THE BLACK SEA,
W70-00048 02H

ALGEMENE KUNSTZIJDE UNIE N.V. (NETHERLANDS).
INCREASE OF PROFIT BY WASTE-HEAT DISCHARGE LOSSES (IN DUTCH),
W70-00299 05G

AMERICAN GEOGRAPHICAL SOCIETY, NEW YORK.
CURRENT OBSERVATIONS ON THREE SURGES IN GLACIER BAY, ALASKA, 1965-1968,
W70-00023 02C

REFERENCES TO GLACIER SURGES IN NORTH AMERICA,
W70-00025 02C

AMERICAN WATER WORKS ASSOCIATION RESEARCH FOUNDATION, NEW YORK.
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
W70-00162 05E

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS.
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,
W70-00002 08A

EFFECTS OF WATER TEMPERATURE ON BED-LOAD MOVEMENT,
W70-00142 08B

AUCKLAND UNIV. (NEW ZEALAND). DEPT. OF GEOGRAPHY.
GEOMORPHIC EFFECTS OF FLOODS IN THE ORERE RIVER CATCHMENT, EASTERN HUNUA RANGES,
W70-00254 02J

BLACK AND VEATCH, KANSAS CITY, MO.
COMMUNITIES OF OVER 1000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1000 PPM OF TOTAL DISSOLVED SOLIDS.
W70-00308 05F

BONNEVILLE POWER ADMINISTRATION, PORTLAND, OREG AND GENERAL ELECTRIC CO, SCHENECTADY, N.Y.
SINGLE-PHASE BRIDGE CONVERTER WITH A NEW CONTROL AND A CORRESPONDING THREE-PHASE CONVERTER--I. OPERATIONAL FEATURES II. METHODS OF CONTROL,
W70-00346 08C

BRISTOL UNIV. (ENGLAND). DEPT. OF BOTANY.
THE DIATOMS OF A CORE FROM ESTHWAITE WATER,
W70-00271 05C

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, CANBERRA (AUSTRALIA). BAAS-BECKING GEOBIOLOGICAL LAB.
THE FORMATION OF PYRITE FROM HYDRATED IRON OXIDE IN AQUEOUS SOLUTION AT 20 DEGREE C,
W70-00244 01B

BUREAU OF RECLAMATION, DENVER, COLO.
FOUNDATION TESTING FOR AUBURN DAM,
W70-00324 08E

LABORATORY INVESTIGATION OF AGING CHARACTERISTICS OF ASPHALT CEMENTS USED IN MEMBRANE LINING CONSTRUCTION,
W70-00330 08G

STRUCTURAL MODEL TESTS OF ARCH DAMS--GLEN CANYON AND NORROW POINT DAMS,
W70-00335 08A

BUREAU OF WATER HYGIENE, CINCINNATI, OHIO.
RESEARCH ON RECREATIONAL USE OF WATERSHEDS AND RESERVOIRS,
W70-00348 06D

CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
STEEL TUNNEL LINER PLATE ASSEMBLY, FABRICATION, TRANSPORTATION AND INSTALLATION IN THE ANGELES TUNNEL,
W70-00327 08A

APPLICATION OF SHOTCRETE IN TUNNEL NO 1 AND TUNNEL NO 3,
W70-00356 08A

CALIFORNIA TOMORROW, SAN FRANCISCO, CALIF.
CONSERVATION PERUSE PROGRESS THROUGH EXPLOITATION,
W70-00415 03D

CALIFORNIA UNIV., BERKELEY. HYDRAULIC ENGINEERING LAB.
A HYDRAULIC MODEL STUDY OF LANDSLIDE-GENERATED WATER WAVES IN BAYS,
W70-00003 08B

CALIFORNIA UNIV., BERKELEY. SCHOOL OF FORESTRY.
NITROGEN STORAGE OF SEVERAL CALIFORNIA FOREST SOIL-VEGETATION SYSTEMS,
W70-00283 02K

CALIFORNIA UNIV., DAVIS.
BIOLOGY AND ECOLOGY OF NITROGEN.
W70-00277 02K

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRONOMY.
INPUTS FOR MAXIMUM PRODUCTIVITY,
W70-00281 02K

EFFECTS OF NITROGEN FROM LEGUMES AND CROP RESIDUES ON SOIL PRODUCTIVITY,
W70-00285 02K

CALIFORNIA UNIV., DAVIS. DEPT. OF SOILS AND PLANT NUTRITION.
THE BIOGEOCHEMISTRY OF NITROGEN,
W70-00278 02K

CALIFORNIA UNIV., IRVINE. DEPT. OF CIVIL ENGINEERING.
DEVELOPMENT OF ROLL-WAVE TRAINS IN OPEN CHANNELS,
W70-00227 08B

CALIFORNIA UNIV., LOS ANGELES, DEPT OF GEOLOGY AND CALIFORNIA UNIV., LOS ANGELES. INST. OF GEOPHYSICS AND PLANETARY PHYSICS.
MANGANESE AND RELATED ELEMENTS IN THE INTERSTITIAL WATER OF MARINE SEDIMENTS,
W70-00262 02L

CARBORUNDUM CO., NIAGARA FALLS, N.Y.
OPERATIONS RESEARCH AND THE MEASUREMENT OF MATERIALS,
W70-00325 08G

CENTRAL ELECTRICITY GENERATING BOARD, LEATHERHEAD (ENGLAND). CENTRAL ELECTRICITY RESEARCH LABS.
VIBRATION OF COOLING-TOWER SHELLS,
W70-00296 08A

CENTRAL ELECTRICITY GENERATING BOARD, LEATHERHEAD (ENGLAND). CENTRAL ELECTRICITY RESEARCH LABS.
REDUCED PUMP HEAD CROSSFLOW COOLING TOWERS,
W70-00320 05D

CENTRAL ELECTRICITY GENERATING BOARD, LONDON (ENGLAND). GENERATION DESIGN DEPT.
RESUME OF THE REPORT ON THE FAILURES,
W70-00143 08A

CENTRAL ELECTRICITY GENERATING BOARD, LONDON (ENGLAND).
CONSEQUENTIAL PROBLEMS ON OTHER CEGB STATIONS,
W70-00145 08A

CENTRAL ELECTRICITY GENERATING BOARD, LONDON (ENGLAND). CENTRAL ELECTRICITY RESEARCH LABS.
RECOVERING THE KINETIC ENERGY OF A FALLING LIQUID IN A COOLING TOWER,
W70-00316 05D

CENTRAL ELECTRICITY GENERATING BOARD, PORTISHEAD (ENGLAND). RESEARCH AND DEVELOPMENT DEPT.
THE MIXING OF WARM WATER FROM THE USKMOUTH POWER STATIONS IN THE ESTUARY OF THE RIVER USK,
W70-00150 05C

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, GRENOBLE (FRANCE). LABORATOIRE DE GLACIOLOGIE.
A CONTRIBUTION TO THE THEORY OF GLACIER SURGES (IN FRENCH), W70-00221 02C

CESKOSLOVENSKA AKADEMIE VED, PRAGUE. HYDROBIOLOGICAL STATION.
CONTRIBUTION TO THE ECOLOGY OF WATER-BLOOM-FORMING BLUE-GREEN ALGAE -APHANIZOMENON FLOS AQUAE AND MICROCYSTIS AERUGINOSA, W70-00274 05C

CITY UNIV., LONDON (ENGLAND).
COMPOSITE ACTION BETWEEN BRICK PANEL WALLS AND THEIR SUPPORTING BEAMS, W70-00339 08A

CITY UNIV., LONDON (ENGLAND). DEPT. OF CIVIL ENGINEERING.
ON THE DISTRIBUTION OF THE FREQUENCY OF RESERVOIR DEFICIT, W70-00041 04A

COLORADO STATE UNIV., FORT COLLINS.
MATHEMATICAL SIMULATION OF A STREAM-AQUIFER SYSTEM, W70-00054 02A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
FLOOD WAVE MODIFICATION ALONG PRISMATIC CHANNELS, W70-00218 08B

CONCEPCION UNIV. (CHILE). DEPARTAMENTO DE MICROBIOLOGIA.
AN INVESTIGATION OF THE NITROGEN-FIXING ABILITY OF NATIVE CHILEAN RHIZOBIA STRAINS AND SOME PROBLEMS RELATED TO THEIR SYMBIOSIS WITH SEVERAL LEGUMES, W70-00286 02K

CONSTRUCTION ESTIMATING, INC. AND GATES-SCARPA AND ASSOCIATES, INC., WEST HARTFORD, CONN.
EARTHWORK QUANTITIES BY RANDOM SAMPLING, W70-00341 08D

CORNELL UNIV., ITHACA, N.Y. DEPT. OF AGRONOMY.
PHYSIOLOGY OF THE SYMBIOSIS BETWEEN RHIZOBIUM AND LEGUMINOUS PLANTS, W70-00290 02K

CORNELL UNIV., ITHACA, N.Y. DEPT. OF WATER RESOURCES ENGINEERING AND AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, COLO. SOIL AND WATER CONSERVATION RESEARCH DIV.
THE USE OF THE SHALLOW WATER EQUATIONS IN RUNOFF COMPUTATION, W70-00056 02A

CORNELL UNIV., ITHACA, N.Y. WATER RESOURCES AND MARINE SCIENCES CENTER.
A SELECTED ANNOTATED BIBLIOGRAPHY ON THE ANALYSIS OF WATER RESOURCE SYSTEMS, W70-00306 10

CORPS OF ENGINEERS, CHICAGO, ILL.
FLOOD PLAIN INFORMATION, WOLF RIVER FROM LAKE POYGAN TO SHAWANO, WISCONSIN. W70-00008 04A

CORPS OF ENGINEERS, PITTSBURGH, PA.
FLOOD PLAIN INFORMATION, FRENCH AND CUSSEWAGO CREEKS, MEADVILLE, PENNSYLVANIA. W70-00010 04A

CORPS OF ENGINEERS, ROCK ISLAND, ILL.
MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS AND SCOTT AND MUSCATINE COUNTIES, IOWA. W70-00001 04A

ROCK RIVER FLOOD PLAIN INFORMATION, ROCK ISLAND COUNTY, ILLINOIS. W70-00004 04A

CORPS OF ENGINEERS, WALTHAM, MASS.
FLOOD PLAIN INFORMATION, WESTFIELD AND LITTLE RIVERS, WESTFIELD, MASSACHUSETTS. W70-00042 04A

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, PRETORIA (SOUTH AFRICA).
FOUNDATION FAILURES OF FOUR ROCKFILL SLOPES, W70-00363 08D

DEFENSE RESEARCH ESTABLISHMENT OTTAWA (ONTARIO). GEOPHYSICS SECTION.
RECENT OBSERVATIONS ON THE SURGING OTTO GLACIER, ELLESMERE ISLAND, W70-00021 02C

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). INLAND WATERS BRANCH.
OBSERVATIONS OF THE SURGE OF STEELE GLACIER, YUKON TERRITORY, CANADA, W70-00009 02C

EVIDENCE OF SURGES ON THE BARNES ICE CAP, BAFFIN ISLAND, W70-00032 02C

DEPARTMENT OF NATIONAL HYDROLOGY (FRANCE).
AUTOMATIC BED DATA ABSTRACTING USING A HYDRAULIC SCALE MODEL (FRENCH), W70-00250 02J

DEPARTMENT OF THE INTERIOR, WASHINGTON, D.C.
EFFECTS OF WATER TEMPERATURE ON THE DISCHARGE OF BED MATERIAL, W70-00152 08B

THE WATER RESOURCE, W70-00272 06G

DEPARTMENT OF WATER AND POWER, LOS ANGELES, CALIF.
OCEAN COOLING WATER SYSTEMS FOR TWO THERMAL PLANTS, W70-00160 05F

DEPARTMENT OF WATER AND SEWERS, CHICAGO, ILL.
LAKE MICHIGAN POLLUTION AND CHICAGO'S SUPPLY, W70-00263 05B

DIENST DER PUBLIEKE WERKEN, AMSTERDAM (NETHERLANDS).
TECHNICAL ASPECTS OF GROUND-WATER RECHARGING (IN DUTCH), W70-00302 04B

DIJKGRAAF VAN HET HOOGHEEMRAADSCHAP VAN DELFLAND (NETHERLANDS).
ADMINISTRATIVE ASPECTS OF (WATER), (IN DUTCH), W70-00297 06D

DREXEL INST. OF TECH., PHILADELPHIA, PA. AND NEW YORK UNIV., BRONX, N.Y. DEPT. OF CIVIL ENGINEERING.
DISPERSION IN FRESH WATER PORTIONS OF ESTUARIES, W70-00068 02L

DU PONT DE NEMOURS (E.I.) AND CO., PHILADELPHIA, PA. AND PPG INDUSTRIES, INC., SPRINGDALE, PA.
SYSTEMS APPROACH TO ORGANIC COATINGS, W70-00358 08G

EAST PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY, DACCA. WATER INVESTIGATION.
INVESTIGATION OF BRAHMAPUTRA RIVER, W70-00219 02E

EBASCO SERVICES, INC., NEW YORK.
TECHNIQUES AND EQUIPMENT NEEDED FOR HVDC STUDIES, W70-00365 08C

ECONOMIC DEVELOPMENT ADMINISTRATION, WASHINGTON, D.C. AND VERMONT UNIV., BURLINGTON.
ALTERNATIVE USES OF THE NATURAL ENVIRONMENT, W70-00414 06B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU UND ERDBAU.
EVIDENCE FOR AN ANCIENT GLACIER SURGE IN THE SWISS ALPS, W70-00027 02C

ELECTRICITY SUPPLY BOARD (IRELAND).
ECONOMIC SIZING OF COOLING TOWERS, W70-00155 05D

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO.
THE FUTURE OF INSTRUMENTATION IN WATER POLLUTION CONTROL, W70-00305 05A

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WEST KINGSTON, R.I.
STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES, W70-00417 05C

FLORIDA UNIV., GAINESVILLE. DEPT. OF BIOENVIRONMENTAL ENGINEERING.
THE MECHANICS OF SURFACE RUNOFF, W70-00055 02E

FOREST SERVICE (USDA) PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, JUNEAU, ALASKA.
MASS WASTING IN COASTAL ALASKA, W70-00164 02J

A LATE-PLEISTOCENE GLACIAL SEQUENCE FROM PRINCE OF WALES ISLAND, ALASKA, W70-00166 02C

FOSTER WHEELER CORP., SAN MATEO, CALIF.
USUAL APPLICATIONS OF COOLING TOWERS, W70-00157 05D

GEOLOGIC SERVICE OF BELGIUM.
INTERPRETATION OF FLUCTUATIONS IN A CARBONIFEROUS LIMESTONE AQUIFER AT HOUSCRON, BELGIUM (FRENCH), W70-00040 02F

GEOLOGICAL SURVEY OF CANADA, CALGARY (ALBERTA).
COMPARISON OF MORAINES FORMED BY SURGING AND NORMAL GLACIERS, W70-00007 02C

GEOLOGICAL SURVEY, COLUMBUS, OHIO. WATER RESOURCES DIV.
THE GROUNDWATER SITUATION IN OHIO, W70-00203 02F

GEOLOGICAL SURVEY, DENVER, COLO.
ANALOG-DIGITAL MODELS OF STREAM-AQUIFER SYSTEMS, W70-00204 02F

PYROLYSIS OF HUMIC AND FULVIC ACIDS, W70-00241 02K

GEOLOGICAL SURVEY, HELENA, MONT. AND PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. SCHOOL OF FOREST RESOURCES.
AN APPLICATION OF SURFACE GEOPHYSICAL TECHNIQUES TO THE STUDY OF WATERSHED HYDROLOGY, W70-00209 02F

GEOLOGICAL SURVEY, HURON, S. DAK. WATER RESOURCES DIV.
A SYSTEM FOR PLANNING AND SCHEDULING WATER RESOURCE STUDIES AND CONSTRUCTION PROJECTS,
W70-00206 06A

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
RELATION OF WATER QUALITY TO STRIPED-BASS MORTALITIES IN THE CARQUINEZ STRAIT OF CALIFORNIA,
W70-00005 05C

RAPID HEAT-FLOW SURVEYING OF GEOTHERMAL AREAS, UTILIZING INDIVIDUAL SNOWFALLS AS CALORIMETERS,
W70-00201 02C

GEOLOGICAL SURVEY, TACOMA, WASH.
RECONNAISSANCE OF GEOLOGY AND OF GROUNDWATER OCCURRENCE IN WHITMAN COUNTY, WASHINGTON,
W70-00012 02F

SEMINAR ON THE CAUSES AND MECHANICS OF GLACIER SURGES, ST. HILAIRE, CANADA, SEPTEMBER 10-11, 1968 A SUMMARY,
W70-00019 02C

DISTRIBUTION OF SURGING GLACIERS IN WESTERN NORTH AMERICA,
W70-00239 02C

GEOLOGICAL SURVEY, TACOMA, WASH. WATER RESOURCES DIV.
WHAT ARE GLACIER SURGES,
W70-00022 02C

GEOLOGICAL SURVEY, WASHINGTON, D.C.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 2. PACIFIC SLOPE BASINS IN CALIFORNIA - KLAMATH AND SMITH RIVER BASINS AND CENTRAL VALLEY DRAINAGE FROM THE EAST,
W70-00052 02E

SEDIMENT MEASUREMENT TECHNIQUES A. FLUVIAL SEDIMENT,
W70-00214 02J

SEDIMENT MEASUREMENT TECHNIQUES F. LABORATORY PROCEDURES,
W70-00215 02J

INVENTORY OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER EASTERN TENNESSEE,
W70-00240 05B

COLOR MIMICRY IN GEOLOGY AND GEOPHYSICS,
W70-00332 07B

GEORGIA STATE COLL., ATLANTA, GA. SCHOOL OF BUSINESS ADMINISTRATION.
FLOOD CONTROL BENEFITS AND THE TENNESSEE VALLEY AUTHORITY,
W70-00416 06B

GOSUDARJTVENNYI GEOLOGICHESKII INSTITUT, LENINGRAD (USSR).
SOME ASPECTS OF THE PROBLEM OF MIXING OF POLLUTED WATER AND SELF-PURIFICATION OF STREAMS (IN RUSSIAN),
W70-00151 05G

HARZA ENGINEERING CO., CHICAGO, ILL. WATER RESOURCES PLANNING DIV. AND METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO.
GROUNDWATER STUDIES--CHICAGOLAND DEEP TUNNEL SYSTEM,
W70-00205 05G

HYDROGEOLOGICAL ENTERPRISE, WARSAW (POLAND).
A RADIOGRAPHIC METHOD OF DETERMINING THE DIRECTION OF GROUND WATER FILTRATION IN DRILL HOLES,
W70-00331 07B

HYDROGEOLOGICAL STATION, IRKUTSK (USSR).
NATURAL RESOURCES OF UNDERGROUND WATERS CONFINED TO THE ZONE OF FREE WATER EXCHANGE OF THE IRKUTSK AMPHITHEATER (RUSSIAN),
W70-00233 02F

HYDRONAUTICS, INC., LAUREL, MD.
DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
W70-00210 08B

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, TORONTO.
THE EVALUATION OF CONCRETE BY OUTDOOR EXPOSURE,
W70-00340 08F

IDAHO UNIV., MOSCOW.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-00036 02G

ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
EVALUATING SANITARY LANDFILL SITES IN ILLINOIS,
W70-00006 05E

ILLINOIS UNIV., URBANA. DEPT. OF CIVIL ENGINEERING.
NONDIMENSIONAL GRADUALLY-VARIED FLOW PROFILES,
W70-00216 02E

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). DEPT. OF ENGINEERING.
PHILOSOPHY OF FAILURE,
W70-00294 08A

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). DEPT. OF AERONAUTICS.
SOME AERODYNAMIC PROBLEMS OF GROUPED COOLING TOWERS,
W70-00298 08A

INNSBRUCK UNIV. (AUSTRIA).
SURGES OF THE VERNAGTFERNER IN THE OTZTAL ALPS SINCE 1599,
W70-00026 02C

INSTITUTO AGRONOMICO, CAMPINAS (BRAZIL).
IMPORTANCE OF NONSYMBIOTIC ORGANISMS IN THE NITROGEN ECONOMY OF TROPICAL SOILS,
W70-00289 02K

INSTITUUT VOOR GEZONDHEIDSTECHNIEK TNO, THE HAGUE (NETHERLANDS).
BIOCHEMICAL EFFECTS OF COOLING WATER DISCHARGE INTO PUBLIC WATERS (IN DUTCH),
W70-00303 05C

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA (AUSTRIA) AND MINISTRY OF NATURAL RESOURCES, NAIROBI (KENYA). DEPT. OF WATER DEVELOPMENT.
THE MEASUREMENT OF HIGH DISCHARGES IN TURBULENT RIVERS USING TRITIUM TRACER,
W70-00035 07B

INTERNATIONAL POWER AND ENGINEERING CONSULTANTS LTD., VANCOUVER (BRITISH COLUMBIA).
SELECTION AND PERFORMANCE OF ANCHORS FOR GUYED TRANSMISSION TOWERS,
W70-00361 08C

INTRUSION-PREPAKT INC., CLEVELAND, OHIO.
REVETMENT CONSTRUCTION BY FABRIFORM PROCESS,
W70-00334 08F

IOWA STATE UNIV., AMES. DEPT. OF CIVIL ENGINEERING AND IOWA STATE UNIV., AMES. ENGINEERING RESEARCH INST.
MATHEMATICAL MODELS FOR EXPRESSING THE BIOCHEMICAL OXYGEN DEMAND IN WATER QUALITY STUDIES,
W70-00059 05B

JAPAN PETROLEUM DEVELOPMENT CORP., TOKYO.
COMPACTION AND MIGRATION OF FLUIDS IN MIOCENE MUDSTONE, NAGAOKA PLAIN, JAPAN,
W70-00246 02F

JOHNS HOPKINS UNIV., BALTIMORE, MD. CHESAPEAKE BAY INST. AND JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF OCEANOGRAPHY.
SHORE EROSION OF THE NORTHERN CHESAPEAKE BAY,
W70-00047 02J

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCE.
AN OPERATIONS RESEARCH APPROACH TO BASIN SEDIMENT CONTROL,
W70-00060 04D

KANSAI ELECTRIC POWER CO. LTD., OSAKA (JAPAN) AND SUMITOMO ELECTRIC INDUSTRIES LTD., OSAKA (JAPAN).
A STUDY ON DANCING OF OVERHEAD LINE BUNDLED CONDUCTORS,
W70-00359 08C

KANSAS STATE UNIV., MANHATTAN. INST. FOR SYSTEMS DESIGN AND OPTIMIZATION.
A NONLINEAR MODEL OF A WATER RESERVOIR SYSTEM WITH MULTIPLE USES AND ITS OPTIMIZATION BY COMBINED USE OF DYNAMIC PROGRAMMING AND PATTERN SEARCH TECHNIQUES,
W70-00208 06B

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.
THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
W70-00062 05C

KARAGANDA POLYTECHNICAL INST. (USSR) AND AKADEMIYA NAUK SSSR. INSTITUT OKEANOLOGII.
THE BALANCE OF SEDIMENTARY MATERIAL IN THE SEA OF AZOV,
W70-00051 02J

LAWRENCE (A. C.) LEATHER CO., SOUTH PARIS, MAINE.
ACTIVATED SLUDGE TREATMENT OF CHROME TANNERY WASTES, A PILOT STUDY OF TREATING COMBINED CHROME TANNERY WASTES AND DOMESTIC SEWAGE.
W70-00163 05D

LESLIE (ROBERT) AND PARTNERS.
HYPERBOLIC COOLING TOWERS,
W70-00291 08A

LINCOLN COLL., CANTERBURY (NEW ZEALAND). DEPT. OF AGRICULTURAL ENGINEERING.
GENERATING SYNTHETIC STREAM-FLOW RECORDS FOR NEW ZEALAND RIVERS,
W70-00251 02E

A MATHEMATICAL CATCHMENT MODEL FOR ESTIMATING RUNOFF,
W70-00257 02A

LOUISIANA STATE UNIV., BATON ROUGE.
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
W70-00309 05B

MARLEY CO.
STATUS OF BIG COOLING TOWERS,
W70-00321 08A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
CIRCULATION AND THERMOCLINE DEVELOPMENT IN A ROTATING LAKE MODEL,
W70-00153 02H

MCGILL UNIV, MONTREAL (QUEBEC). DEPT. OF METALLURGICAL ENGINEERING AND MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF GEOGRAPHY.
DEFORMATION OF ICE UNDER HIGH INTERNAL SHEAR STRESSES,

W70-00018 02C

MCGILL UNIV., MONTREAL (QUEBEC).
WAS THE GOOD FRIDAY GLACIER ON AXEL HEIBERG ISLAND SURGING,
W70-00030 02C

METEOROLOGICAL SERVICE OF THE CITY OF HANOI (NORTH VIETNAM).
SOME PECULIARITIES OF THE FORMATION OF TIDAL PHENOMENA IN THE SOUTH CHINA SEA (RUSSIAN),
W70-00235 02L

MIAMI UNIV., FLA. INST. OF MARINE SCIENCES.
TRITIUM IN THE EQUATORIAL ATLANTIC CURRENT SYSTEM,
W70-00224 02K

MIAMI UNIV., OXFORD, OHIO.
GEOLOGIC AND GEOGRAPHIC CONTROLS UPON THE RATE OF SOLUTE REMOVAL FROM SELECTED COASTAL RIVER BASINS BETWEEN HALF MOON BAY AND DAVENPORT, CALIFORNIA,
W70-00067 02L

MICHIGAN UNIV., ANN ARBOR. DEPT. OF RESOURCE PLANNING AND CONSERVATION.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS.
W70-00140 06G

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF PUBLIC HEALTH.
COLLECTION AND INTERPRETATION OF STREAM WATER QUALITY DATA,
W70-00063 05A

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, LOWESTOFT (ENGLAND). FISHERIES LAB.
CURRENT SYSTEM IN THE NORTHERN IRISH SEA,
W70-00202 02L

MINISTRY OF IRRIGATION AND POWER, NEW DELHI (INDIA).
DETERMINATION OF THE OPTIMUM STORAGE CAPACITY OF RESERVOIRS AND THE ASSOCIATED PROBABILITIES,
W70-00038 02E

MINISTRY OF WORKS, NAPIER (NEW ZEALAND).
VARIATIONS OF RAINFALL FREQUENCY IN RELATION TO DROUGHT ON THE EAST COAST,
W70-00256 02A

MINISTRY OF WORKS, WELLINGTON (NEW ZEALAND). CIVIL DIV.
GENERATION OF MONTHLY STREAM-FLOW DATA,
W70-00255 02E

MISSOURI UNIV., KANSAS CITY. DEPT. OF CHEMISTRY.
SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM WITH XYLENOL ORANGE AND METHYLTHYMOL BLUE,
W70-00260 05A

MISSOURI UNIV., ROLLA. DEPT. OF CIVIL ENGINEERING.
WATERSHED HYDRAULICS IN THE LABORATORY,
W70-00065 02A

MONSANTO CO., ST. LOUIS, MO.
THE ICE-DAM, POWDER-FLOW THEORY OF GLACIER SURGES,
W70-00017 02C

MUSEUM OF NATURAL HISTORY, REYKJAVIK (ICELAND). DEPT. OF GEOLOGY AND GEOGRAPHY.
GLACIER SURGES IN ICELAND, WITH SPECIAL REFERENCE TO THE SURGES OF BRUARJOKULL,
W70-00029 02C

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D.C.
CONVECTIVE CIRCULATION IN WATER INDUCED BY EVAPORATIVE COOLING,
W70-00156 02D

NATIONAL MECHANICAL ENGINEERING RESEARCH INST., PRETORIA (SOUTH AFRICA).
FAILURE OF FRACTURED ROCK,
W70-00350 08E

NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
MATHEMATICAL ASPECTS,
W70-00295 08A

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).
ISOLATION AND CULTURE OF TOXIC STRAINS OF ANABAENA FLOS-AQUAE (LYNGB.) DE BREB.,
W70-00273 05C

NATIONAL TECHNICAL UNIV., ATHENS (GREECE).
DETERMINATION OF THE COMPRESSIVE STRENGTH OF ROCK IN SITU OR IN TEST BLOCKS USING A DIAMOND DRILL,
W70-00357 08E

NEBRASKA UNIV., LINCOLN.
BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS.
W70-00139 03A

NETHERLANDS RIJKSWATERSTAAT, ARNHEM. ENGINEERING DEPT. OF COASTAL RESEARCH.
A MATHEMATICAL THEORY ABOUT SAND WAVES AND ITS APPLICATION ON THE DUTCH WADDEN ISLE OF VLIELAND,
W70-00043 02J

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
HORIZONTAL TWO-DIMENSIONAL DENSITY CURRENT,
W70-00319 08B

NORSK POLARINSTITUTT, OSLO.
GLACIER SURGES IN WEST SPITSBERGEN,
W70-00031 02C

NORTH AMERICAN WEATHER CONSULTANTS, GOLETA, CALIF.
DESIGN OF CLOUD SEEDING PROGRAM,
W70-00230 03B

NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH.
MOISTURE AND ENERGY DISTRIBUTION WITHIN A SLOPING SOIL MASS DUE TO A FINITE DURATION STEADY RAINFALL,
W70-00307 02G

NORTH DAKOTA UNIV., GRAND FORKS.
THE LIMNOBIOCHEMISTRY OF DEVILS LAKE, NORTH DAKOTA,
W70-00311 05C

NORTHERN ILLINOIS UNIV., DEKALB. DEPT. OF GEOLOGY.
GROUNDWATER GEOLOGY OF ALLUVIAL FAN AQUIFERS LOCATED IN THE WESTERN THIRD OF THE GWYDIR RIVER VALLEY, NEW SOUTH WALES, AUSTRALIA,
W70-00207 04B

NORTHWESTERN UNIV., EVANSTON, ILL. DEPT. OF MATERIALS SCIENCE AND ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, N.H.
WATER LUBRICATION MECHANISM OF GLACIER SURGES,
W70-00016 02C

OAK RIDGE NATIONAL LABORATORY, TENN. RADIATION ECOLOGY SECTION AND COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRONOMY.
THE NITROGEN ECONOMY OF GRASSLAND AND DUNE SOILS,
W70-00284 02K

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER AND AGRICULTURAL RESEARCH SERVICE, COLUMBUS, OHIO.
EFFECT OF TILE DEPTH, SPACING, AND CROPPING PRACTICES ON DRAIN DISCHARGE,
W70-00351 03F

OHIO STATE UNIV. RESEARCH FOUNDATION, COLUMBUS. INST. OF POLAR STUDIES.
THE 1978-1980 SURGE OF THE SHERMAN GLACIER, SOUTH-CENTRAL ALASKA,
W70-00024 02C

OKLAHOMA UNIV., NORMAN. DEPT. OF CIVIL ENGINEERING AND SANITARY SCIENCE.
MODEL OF OPTIMAL COMBINATION OF TREATMENT AND DILLUTION,
W70-00064 05D

OREGON STATE UNIV., CORVALLIS. DEPT. OF FISH AND GAME MANAGEMENT OREGON STATE UNIV., CORVALLIS. DEPT. OF BOTANY AND OREGON STATE UNIV., CORVALLIS. PACIFIC COOPERATIVE WATER POLLUTION AND FISHERIES RESEARCH LABS.
PRIMARY PRODUCTION IN LABORATORY STREAMS,
W70-00265 05C

PENNSYLVANIA DEPT. OF HIGHWAYS.
INVESTIGATION OF CONCRETE PROTECTIVE SEALANTS AND CURING COMPOUNDS,
W70-00338 08F

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
MECHANISMS OF FROST ACTION IN CONCRETE AGGREGATES,
W70-00362 08F

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF MINERAL PREPARATION AND PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
CONTROL OF MINE DRAINAGE WATER,
W70-00069 05G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
A WATERSHED FLOW MODEL OF STOCHASTIC STRUCTURE,
W70-00053 02A

PRAIRIE FARM REHABILITATION ADMINISTRATION (SASKATCHEWAN).
FOUNDATION ANCHOR PILES IN CLAY-SHALES,
W70-00360 08D

PRINCETON UNIV., N.J. DEPT. OF CHEMICAL ENGINEERING.
QUANTITATIVE ANALYSIS FOR CORROSION STUDIES BY THE MOSSBAUER EFFECT,
W70-00046 08G

PRINCETON UNIV., N.J. DEPT. OF GEOLOGY.
ICE-SHEET SURGES AND THE GEOLOGICAL RECORD,
W70-00013 02C

RAIKES AND PARTNERS, ROME (ITALY).
A NEW METHOD OF INVESTIGATING RIVER RECESSION CURVES,
W70-00353 02E

RESEARCH COUNCIL OF ALBERTA, EDMONTON.
ROCK VOLUME AND PORE VOLUME DATA FOR PLAINS REGION OF WESTERN CANADA SEDIMENTARY BASIN BETWEEN LATITUDES 49 AND 60 DEG N,
W70-00248 02F

RIO GRANDE DO SUL, PORTO ALEGRE (BRAZIL). FACULDADE DE AGRONOMIA E VETERINARIA.
INOCULATION OF LEGUMES IN BRAZIL,
W70-00287 02K

ROYAL INST. OF TECH., STOCKHOLM (SWEDEN).
LIGHTNING SURGES ON DC CABLES CONNECTED TO OVERHEAD LINES,
W70-00349 08C

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. DEPT. OF GEOGRAPHY.
SOME EFFECTS OF URBANIZATION ON RUNOFF AS EVALUATED BY THORNTHWAITE WATER BALANCE MODELS,

W70-00057 04C

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. WATER RESOURCES RESEARCH INST.
CONCEPTUAL PROBLEMS IN WATER-QUALITY ECONOMICS, W70-00313 06B

PRELIMINARY MASS BALANCE OF BOD ON THREE NEW JERSEY RIVERS, W70-00314 05B

SAN DIEGO STATE COLL., CALIF. DEPT. OF CIVIL ENGINEERING.
AMMONIA NITROGEN LOSSES FROM STREAMS, W70-00267 05G

SCOTT POLAR RESEARCH INST., CAMBRIDGE (ENGLAND) AND CAMBRIDGE UNIV. (ENGLAND). CAVENDISH LAB.
PROPAGATION OF GLACIER SURGES, W70-00033 02C

SCOTT POLAR RESEARCH INST., CAMBRIDGE (ENGLAND).
INITIATION OF GLACIER SURGES, W70-00015 02C

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIF.
THE CHANNELIZED FLOW OF TURBIDITY CURRENTS WITH APPLICATION TO MONTEREY DEEP-SEA FAN CHANNEL, W70-00223 02L

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
INVESTIGATION OF WATER LOSSES TO SINKHOLES IN THE PAHASAPA LIMESTONE AND THEIR RELATION TO RESURGENT SPRINGS, BLACK HILLS, SOUTH DAKOTA, W70-00310 02G

SOUTH DAKOTA STATE UNIV., BROOKINGS.
HYDROLOGY OF SMALL DRAINAGE BASINS FOR DEVELOPING HYDRAULIC DESIGN CRITERIA, W70-00137 02E

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF BACTERIOLOGY.
NITROGEN-FIXING PLANTS AND THEIR SYMBIONTS, W70-00280 02K

SOUTHAMPTON UNIV. (ENGLAND).
SEA PLANTS FOR FOOD, W70-00161 03C

SOUTHERN CALIFORNIA EDISON CO., LOS ANGELES, CALIF.
COOLING WATER FOR STEAM ELECTRIC STATION ON TIDEWATER, W70-00159 05D

SOUTHERN MISSISSIPPI UNIV., HATTIESBURG. DEPT. OF ECONOMICS.
A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION, W70-00213 06B

SREDNEAZIATSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT IRRIGATSII, TASHKENT (USSR).
CALCULATIONS PERTAINING TO THE DESALINATION OF SALT-CONTAINING FORMATIONS UNDERLAIN BY AN AQUIFER OF GOOD PERMEABILITY (RUSSIAN), W70-00243 03A

STATE ZOOLOGICAL INST. AND MUSEUM, HAMBURG (WEST GERMANY). HYDROBIOLOGICAL STATION.
CHARACTERISTICS OF HYPERTROPHIC LAKES AND CANALS IN CITIES, W70-00268 05C

STOCKHOLM UNIV. (SWEDEN). DEPT. OF PHYSICAL GEOGRAPHY.
SOME COMMENTS ON GLACIER SURGES IN EASTERN SVALBARD, W70-00028 02C

SWEDISH GEOTECHNICAL INST., STOCKHOLM.
SHEAR STRENGTH OF REINFORCED CONCRETE BEAMS, W70-00328 08F

SYDNEY UNIV. (AUSTRALIA).
SYNTHETIC TESTING USING CAPACITIVE CURRENT VOLTAGE SOURCES, W70-00526 08C

SYDNEY UNIV. (AUSTRALIA). DEPT. OF GEOGRAPHY.
A NEWLY-IDENTIFIED PROCESS OF POINT BAR FORMATION IN NATURAL STREAMS, W70-00034 02J

TALLINN POLYTECHNIC INST. (USSR).
COMPUTATION OF LONGITUDINAL MIXING OF POLLUTION MATTER IN FLOWS (IN RUSSIAN), W70-00146 05C

COMPUTATION OF WASTE WATER MIXING AT SOME FIGURES OF WASTE LOAD OF FLOWS (IN RUSSIAN), W70-00147 05C

COMPUTATION OF OXYGEN BALANCE OF WATERS POLLUTED BY WASTE WATERS (IN RUSSIAN), W70-00149 05C

TASHKENT UNIV. (USSR).
DESALINATION UNDER THE CONDITIONS OF NO WATER DRAINAGE (RUSSIAN), W70-00237 03A

TECHNION - ISRAEL INST. OF TECH., HAIFA AND MINISTRY OF AGRICULTURE, TEL AVIV.
REDUCED SODIUM EXCHANGE CAPACITY IN UNSATURATED FLOW, W70-00045 02K

TECHNION - ISRAEL INST. OF TECH., HAIFA. HYDRAULIC LAB.
THIESSEN COEFFICIENTS BY A MONTE CARLO PROCEDURE, W70-00039 07B

TECHNISCHE HOCHSCHULE, KARLSRUHE (WEST GERMANY).
STUDY OF GROUND WATER FLOW IN JOINTED ROCKS AND ITS EFFECTS ON THE STABILITY OF SOLID ROCKS (FRENCH), W70-00249 02F

TENNESSE VALLEY AUTHORITY, MUSCLE SHOALS, ALA. AND IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY.
SIGNIFICANCE OF THE NITRIFICATION REACTION IN NITROGEN BALANCES, W70-00282 02K

TENNESSEE VALLEY AUTHORITY, KNOXVILLE.
COMBINED CONDENSER COOLING SYSTEM UPS PLANT AVAILABILITY, W70-00300 05G

TIPPETTS-ABBETT-MCCARTHY-STRATTON, NEW YORK.
ONE-DIMENSIONAL ANALYSIS OF FLOODS AND TIDES IN OPEN CHANNELS, W70-00226 02E

TLLINN POLYTECHNIC INST. (USSR).
THE ENGINEERING CALCULATION OF THE PERMITTED LOADS OF THE POLLUTED WATER FLOWS (IN RUSSIAN), W70-00148 05C

TOKUGAWA INST. FOR BIOLOGICAL RESEARCH, TOKYO (JAPAN).
CORRELATION BETWEEN PHOTOSYNTHESIS AND LIGHT-INDEPENDENT METABOLISM IN THE GROWTH OF CHLORELLA, W70-00261 05C

TORONTO UNIV. (ONTARIO).
PROFILES OF THE ROUND TURBULENT JET IN A CROSS FLOW, W70-00318 08B

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
GLACIER SURGES IN THE KARAKORAM HIMALAYA (CENTRAL ASIA), W70-00222 02C

TORONTO UNIV. (ONTARIO). DEPT. OF MECHANICAL ENGINEERING.
THE ROUND TURBULENT JET IN A CROSS WIND, W70-00154 08A

TULSA UNIV., OKLA.
CONTEMPORARY NONMARINE SEDIMENTATION IN SOVIET CENTRAL ASIA, W70-00247 02J

UNIVERSITY COLL., LONDON (ENGLAND). DEPT. OF CIVIL ENGINEERING.
STRUCTURAL DESIGN PHILOSOPHY, W70-00144 08A

UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI (GHANA) AND MASSACHUSETTS INST. OF TECH., CAMBRIDGE. HYDRODYNAMICS LAB.
THERMAL STRATIFICATION IN LAKES ANALYTICAL AND LABORATORY, W70-00141 02H

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
SPREAD OF BUOYANT JETS AT THE FREE SURFACE, W70-00232 08B

UTAH STATE UNIV., LOGAN. COLL. OF NATURAL RESOURCES.
MANIPULATION OF WATER USE IN AN ASPEN FOREST, W70-00058 03B

VICTORIA UNIV., WELLINGTON (NEW ZEALAND). DEPT. OF CHEMISTRY.
THE CLIMATIC EFFECTS OF LARGE-SCALE SURGES OF ICE SHEETS, W70-00014 02C

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA).
INFLUENCE OF ELECTRIC POWER PLANT ON LIMNOLOGICAL CONDITIONS OF RESERVOIRS (IN GERMAN), W70-00293 05C

WASHINGTON UNIV., SEATTLE. DEPT. OF ELECTRICAL ENGINEERING.
GLACIAL ACTIVITY PRECEDING THE 1956 MULDROW GLACIER SURGE IN ALASKA, W70-00020 02C

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
WINTER CIRCULATION IN THE GULF OF ALASKA, W70-00220 02L

THE NITROGEN CYCLE IN THE SEA, W70-00279 02K

WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY.
CHANGES IN LAKE WASHINGTON FOLLOWING AN INCREASE IN THE NUTRIENT INCOME, W70-00270 05C

WATER POLLUTION RESEARCH LAB., STEVANAGE (ENGLAND).
EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - II, W70-00158 05C

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
SOME ASPECTS OF THE EUTROPHICATION OF WATER, W70-00266 05C

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
INSTABILITY OF FLAT BED IN ALLUVIAL CHANNELS, W70-00217 08B

FLOW RETARDANCE IN VEGETATED CHANNELS, W70-00228 08B

WEST VIRGINIA CENTER FOR APPALACHIAN STUDIES AND DEVELOPMENT, MORGANTOWN.
EFFECT OF AN ACID-WATER ENVIRONMENT UPON THE SYNTHESIS OF GROWTH FACTORS (VITAMINS) BY BACTERIA,
W70-00312 05C

WISCONSIN UNIV., MADISON.
HEAT BUDGET OF AN ICE COVERED INLAND LAKE,
W70-00317 02C

WISCONSIN UNIV., MADISON. DEPT. OF BOTANY.
PHYTOTOXICITY OF IMIDAZOLINE DERIVATIVES AND RELATED COMPOUNDS,
W70-00275 05C

WYOMING UNIV., LARAMIE.
WATER RESOURCE OBSERVATORY CLIMATOLOGICAL DATA WATER YEAR 1968.
W70-00138 07C

ACCESSION NUMBER INDEX

04A	W70-00001
08A	W70-00002
08B	W70-00003
04A	W70-00004
05C	W70-00005
05E	W70-00006
02C	W70-00007
04A	W70-00008
02C	W70-00009
04A	W70-00010
04C	W70-00011
02F	W70-00012
02C	W70-00013
02C	W70-00014
02C	W70-00015
02C	W70-00016
02C	W70-00017
02C	W70-00018
02C	W70-00019
02C	W70-00020
02C	W70-00021
02C	W70-00022
02C	W70-00023
02C	W70-00024
02C	W70-00025
02C	W70-00026
02C	W70-00027
02C	W70-00028
02C	W70-00029
02C	W70-00030
02C	W70-00031
02C	W70-00032
02C	W70-00033
02J	W70-00034
07B	W70-00035
02G	W70-00036
02A	W70-00037
02E	W70-00038
07B	W70-00039
02F	W70-00040
04A	W70-00041
04A	W70-00042
02J	W70-00043
02J	W70-00044
02K	W70-00045
08G	W70-00046
02J	W70-00047
02H	W70-00048
02J	W70-00049
02J	W70-00050
02J	W70-00051
02E	W70-00052
02A	W70-00053
02A	W70-00054
02E	W70-00055
02A	W70-00056
04C	W70-00057
03B	W70-00058
05B	W70-00059
04D	W70-00060
06E	W70-00061
05C	W70-00062
05A	W70-00063
05D	W70-00064
02A	W70-00065
02A	W70-00066
02L	W70-00067
02L	W70-00068
05G	W70-00069
06E	W70-00070
06E	W70-00071
06E	W70-00072
06E	W70-00073
06E	W70-00074
06E	W70-00075
06E	W70-00076
06E	W70-00077
06E	W70-00078
06E	W70-00079
06E	W70-00080
06E	W70-00081
06E	W70-00082
04A	W70-00083
04A	W70-00084
06D	W70-00085
05G	W70-00086
04D	W70-00087
06D	W70-00088
04A	W70-00089
03F	W70-00090
04C	W70-00091
04A	W70-00092
05G	W70-00093
06E	W70-00094
06E	W70-00095
06E	W70-00096
06E	W70-00097
06E	W70-00098
06E	W70-00099
06E	W70-00100
06E	W70-00101
06E	W70-00102
06E	W70-00103
04C	W70-00104
06E	W70-00105
06E	W70-00106
05G	W70-00107
06E	W70-00108
06E	W70-00109
06E	W70-00110
06E	W70-00111
03E	W70-00112
06E	W70-00113
06E	W70-00114
06E	W70-00115
06E	W70-00116
06E	W70-00117
06E	W70-00118
06E	W70-00119
06E	W70-00120
06E	W70-00121
06E	W70-00122
04A	W70-00123
04A	W70-00124
04A	W70-00125
04A	W70-00126
04A	W70-00127
06B	W70-00128
06E	W70-00129
06E	W70-00130
06E	W70-00131
06E	W70-00132
06E	W70-00133
06E	W70-00134
05G	W70-00135
06E	W70-00136
02E	W70-00137
07C	W70-00138
03A	W70-00139
06G	W70-00140
02H	W70-00141
08B	W70-00142
08A	W70-00143
08A	W70-00144
08A	W70-00145
05C	W70-00146
05C	W70-00147
05C	W70-00148
05C	W70-00149
05C	W70-00150
05G	W70-00151
08B	W70-00152
02H	W70-00153
08A	W70-00154
05D	W70-00155
02D	W70-00156
05D	W70-00157
05C	W70-00158
05D	W70-00159
05F	W70-00160
03C	W70-00161
05E	W70-00162
05D	W70-00163
02J	W70-00164
06E	W70-00165
02C	W70-00166
05G	W70-00167
05G	W70-00168
04A	W70-00169
04A	W70-00170
05G	W70-00171
05G	W70-00172
05G	W70-00173
05G	W70-00174
05G	W70-00175
04C	W70-00176
05G	W70-00177
05G	W70-00178
04B	W70-00179
04A	W70-00180
05G	W70-00181
04A	W70-00182
04A	W70-00183
06D	W70-00184
06D	W70-00185
05G	W70-00186
06E	W70-00187
03E	W70-00188
04A	W70-00189
04C	W70-00190
04A	W70-00191
04A	W70-00192
04D	W70-00193
04A	W70-00194
04A	W70-00195
06B	W70-00196
04A	W70-00197
04C	W70-00198
03E	W70-00199
04A	W70-00200
02C	W70-00201
02L	W70-00202
02F	W70-00203
02F	W70-00204
05G	W70-00205
06A	W70-00206
04B	W70-00207
06B	W70-00208
02F	W70-00209
08B	W70-00210
02F	W70-00211
06E	W70-00212
06B	W70-00213
02J	W70-00214
02J	W70-00215
02E	W70-00216
08B	W70-00217
08B	W70-00218
02E	W70-00219
02L	W70-00220
02C	W70-00221
02C	W70-00222
02L	W70-00223
02K	W70-00224
04A	W70-00225
02E	W70-00226
08B	W70-00227
08B	W70-00228
04A	W70-00229
03B	W70-00230
02L	W70-00231
08B	W70-00232
02F	W70-00233
02L	W70-00234
02L	W70-00235
06E	W70-00236
03A	W70-00237
06E	W70-00238
02C	W70-00239
05B	W70-00240
02K	W70-00241
01A	W70-00242
03A	W70-00243
01B	W70-00244
04A	W70-00245
02F	W70-00246
02J	W70-00247
02F	W70-00248
02F	W70-00249
02J	W70-00250
02E	W70-00251
02J	W70-00252
02L	W70-00253
02J	W70-00254
02E	W70-00255
02A	W70-00256
02A	W70-00257
02K	W70-00258
02L	W70-00259
05A	W70-00260
05C	W70-00261
02L	W70-00262
05B	W70-00263
05C	W70-00264
05C	W70-00265
05C	W70-00266
05G	W70-00267
05C	W70-00268
05G	W70-00269
05C	W70-00270
05C	W70-00271
06G	W70-00272
05C	W70-00273
05C	W70-00274
05C	W70-00275
03D	W70-00276
02K	W70-00277
02K	W70-00278
02K	W70-00279
02K	W70-00280
02K	W70-00281
02K	W70-00282
02K	W70-00283
02K	W70-00284
02K	W70-00285
02K	W70-00286
02K	W70-00287
02K	W70-00288
02K	W70-00289
02K	W70-00290
08A	W70-00291
05G	W70-00292
05C	W70-00293
08A	W70-00294
08A	W70-00295
08A	W70-00296
06D	W70-00297
08A	W70-00298
05G	W70-00299
05G	W70-00300

ACCESSION NUMBER INDEX

06E	W70-00301
04B	W70-00302
05C	W70-00303
03D	W70-00304
05A	W70-00305
10	W70-00306
02G	W70-00307
05F	W70-00308
05B	W70-00309
02G	W70-00310
05C	W70-00311
05C	W70-00312
06B	W70-00313
05B	W70-00314
06E	W70-00315
05D	W70-00316
02C	W70-00317
08B	W70-00318
08B	W70-00319
05D	W70-00320
08A	W70-00321
08E	W70-00322
08E	W70-00323
08E	W70-00324
08G	W70-00325
08C	W70-00326
08A	W70-00327
08F	W70-00328
06E	W70-00329
08G	W70-00330
07B	W70-00331
07B	W70-00332
08E	W70-00333
08F	W70-00334
08A	W70-00335
04A	W70-00336
07B	W70-00337
08F	W70-00338
08A	W70-00339
08F	W70-00340
08D	W70-00341
06E	W70-00342
02J	W70-00343
02E	W70-00344
06E	W70-00345
08C	W70-00346
08A	W70-00347
06D	W70-00348
08C	W70-00349
08E	W70-00350
03F	W70-00351
06E	W70-00352
02E	W70-00353
04A	W70-00354
04A	W70-00355
08A	W70-00356
08E	W70-00357
08G	W70-00358
08C	W70-00359
08D	W70-00360
08C	W70-00361
08F	W70-00362
08D	W70-00363
06E	W70-00364
08C	W70-00365
06E	W70-00366
04A	W70-00367
04D	W70-00368
06E	W70-00369
06E	W70-00370
03D	W70-00371
06E	W70-00372
04A	W70-00373
04A	W70-00374
04A	W70-00375
04A	W70-00376
04A	W70-00377
06E	W70-00378
06G	W70-00379
06B	W70-00380
05G	W70-00381
05E	W70-00382
06E	W70-00383
06E	W70-00384
06E	W70-00385
05G	W70-00386
04A	W70-00387
04A	W70-00388
04A	W70-00389
04A	W70-00390
05G	W70-00391
04D	W70-00392
04A	W70-00393
05G	W70-00394
04A	W70-00395
04A	W70-00396
05G	W70-00397
04A	W70-00398
05G	W70-00399
05G	W70-00400
05G	W70-00401
05G	W70-00402
03D	W70-00403
04A	W70-00404
04A	W70-00405
04A	W70-00406
04D	W70-00407
04A	W70-00408
06E	W70-00409
06E	W70-00410
06E	W70-00411
06E	W70-00412
06B	W70-00413
06B	W70-00414
03D	W70-00415
06B	W70-00416
05C	W70-00417

ABSTRACT SOURCES

Source	Accession Numbers	Total
A. Centers of Competence		
U.S. Geological Survey - Hydrology	W70-00001 - 00010 00012 - 00060 00062 - 00069 00201 - 00211 00213 - 00224 00226 - 00235 00237, 00239 - 00244 00246 - 00260	122
University of Florida - Eastern U.S. Water Law	W70-00070 - 00136 00167 - 00200 00368 - 00412 00011, 00061, 00165, 00212, 00225, 00236, 00238, 00245, 00276, 00301, 00304	157
Vanderbilt University - Thermal Pollution	W70-00141 - 00161 00291 - 00300 00302 - 00303 00315 - 00321	40
University of Wisconsin - Eutrophication	W70-00261 - 00275 00277 - 00290	29
Bureau of Reclamation, U.S. Department of the Interior - Engineering Works	W70-00322 - 00367	46
Rutgers - The State University - Water Resources Economics	W70-00413 - 00416 00313 - 00314	6
Cornell University - Policy Models for Water Resources Systems	W70-00306	1
B. Others:		
Federal Water Pollution Control Administration, U.S. Department of the Interior	W70-00162 - 00163 00417, 00305	4
Office of Saline Water - U.S. Department of the Interior	W70-00308	1
Forest Service - U.S. Department of Agriculture	W70-00164, 00166	2
Office of Atmospheric Research - U.S. Bureau of Reclamation	W70-00140	1
South Dakota Water Resources Institute	W70-00137, 00310	2
Wyoming Water Resources Research Institute	W70-00138	1
Nebraska Water Resources Research Institute	W70-00139	1
North Carolina Water Resources Research Institute	W70-00307	1

ABSTRACT SOURCES

Source	Accession Numbers	Total
Louisiana Water Resources Research Institute	W70-00309	1
North Dakota Water Resources Research Institute	W70-00311	1
West Virginia Water Research Institute	W70-00312	1
	Total	417

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

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